GAUDEO

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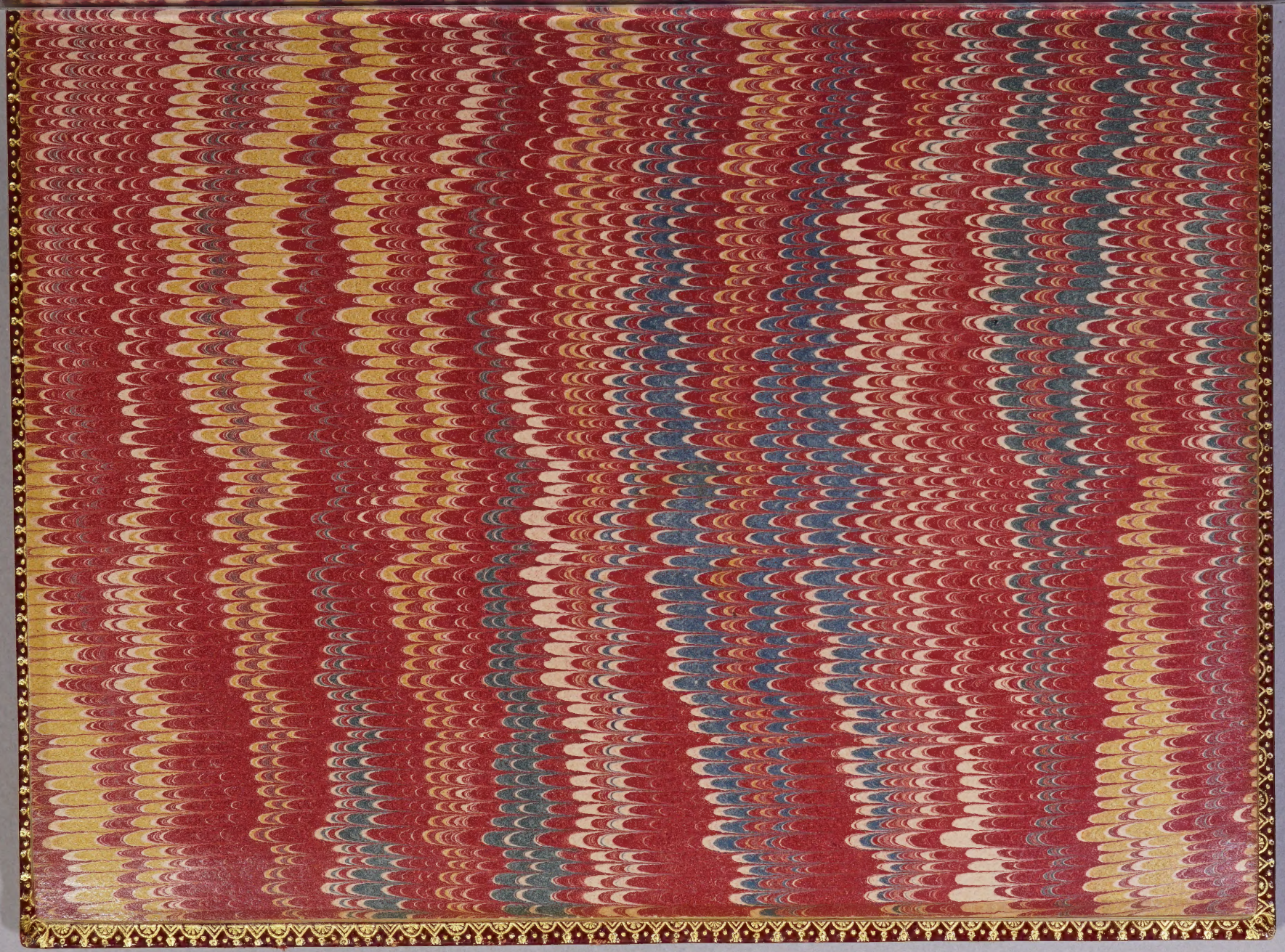
John Carter Brown.



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BOOKS of Navigation Printed for and Sold by Richard Mount, *at the ancient Shop at the* Poſtern *on* Tower-Hill.

THE Mariners Magazine; containing the Art of Navigation, *&c.* By Capt. *Sturmey.*
The Coaſting Pilot for *England*, *Holland*, *France*, *Flanders*, *&c.*
The Engliſh Pilot for the Channel.
The Engliſh Pilot for the Streights.
The Engliſh Pilot for the *Weſt-Indies.*
The Engliſh Pilot for the *Eaſt-Indies.*
Sea-Atlas, containing Charts of the Sea-Coaſts of the whole World.
The Mariners New Kalendar. By *Nathaniel Colſon.*
The Seaman's Kalendar. By *Henry Phillips.*
The Seaman's Practice. By *Richard Norwood.*
Norwood's Doctrine of Triangles, (with Logarithms) applied to Navigation.
A Syſtem of Navigation, being a Treatiſe of the whole Art. By *M. Norwood.*
Practical Navigation, being an Introduction to the whole Art. By *J. Seller.*
The Art of Navigation. By *Daniel Newhouſe.*
Errors in Navigation, detected and corrected. By *Edw. Wright.*
A Light to the Art of Gunnery, containing moſt neceſſary Concluſions for the Practic of Gunnery, either for Sea or Land-Service. By Capt. *Thomas Binning.*
The Safeguard of Sailers; deſcribing the Sea-Coaſts.
Advancement of the Art of Navigation. By *Henry Phillips.*
The Compleat Modeliſt, or Art of Rigging; ſhewing how to raiſe the Model of any Ship or Veſſel, either in Proportion or out of Proportion; and to find the Length and Bigneſs of every Rope in all Veſſels exactly, with the weight of their Anchors and Cables. By *T. Miller.*
The Boarſwain's Art; ſhewing the Art of Rigging of any Ship. By *Henry Bond.*
The Compleat Ship-wright; teaching the Proportions uſed by Ship-wrights, according to their Cuſtom of Building; with the drawing of a Draught, the making and marking of a Bend of Moulds, with a Table of Squares. By *Edm. Buſhnel*, Ship-Wright.
The Geometrical Seamen. By *Henry Phillips.*
The Seaman's Companion. By *M. Norwood.*
The Seaman's Glaſs, ſhewing the uſe of the plain Scale in Navigation, *&c.*
Sea-Dialogues; and a Dictionary explaining all the Parts of a Ship, with the words of Art and Phraſes uſed at Sea. By Capt. *Boteler.*
An Epitome of the whole Art of Navigation, containing an eaſy methodical way to become a compleat Navigator. By *James Atkinſon*, Teacher of the Mathematicks.
Epitomy of Navigation, ſhewing the Doctrine of Triangles, and all the three Kinds of Sailing; Aſtronomy and Geography, with uſeful Tables in Navigation. By *H. Gellibrand.*
Norwood's Epitomy, containing Plain and *Mercator*'s Sailing, and uſeful Tables in Navigation. With large and uſeful Additions, by *James Atkinſon.*
The Mariners Compaſs rectified. By *A. Wakely.* corrected and much enlarged by *J. Atkinſon.*
The uſe of the double Scale of Proportion in Navigation, *&c.* By *S. Partridge.*
The Seaman's Tutor. By *Peter Perkins.*
Mathematical Manual; of Navigation, Gunnery, Dyalling, *&c.* By *Henry Phillips.*
The Rule of Proportion explain'd in Navigation, *&c.* By *Edmond Wingate.*

There are alſo ſold all ſorts of Mathematical and Sea-Books in Engliſh, Waggoners or Charts for all parts of the World; or Books of any other Subjects, as Divinity, Hiſtory, Travels, *&c.* and Bibles, or any other Books bound; Journal Books rul'd; all ſorts of Paper or Paper-Books; the beſt Ink, and other Stationary Ware, at Reaſonable Rates.

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A Deſcription of a Ship with all her Tackling.

Mizan Maſt: And running Rigging.

1 Mizan Maſt & Top-maſt.
2. Mizan Yard and Sail.
3 The Croſs tree yard.
4 Mizan Topſail yard and Sail
5 Mizan Top and Cap.
6 Mizan Topſail Lifts.
7 Mizan Topſail Sheets.
8 Mizan Shrowds.
9 Mizan Topmaſt Shrowds.
10 Mizan Chains.
11 The Gallery.
12 Tafferail. (Enſign.
13 The Cap Enſign-ſtaff and
14 The Quarter Deck.
15 The half Deck.
16 The Mizan Sheet.
17 Mizan Topſail Braces.
18 Mizan Topſail Bowlines.
19 Mizan Topſail Clewlins.
20 Mizan Brailes.
21 Mizan Topmaſts Stay.
22 Mizan Stay,
23 Mizan Sheet.
24 Yards & Oars for the Boat
25 The Ships Boat.
26 A hoiſtingline for Pennant.
27 Mizan Bowlin.
28 A Mizan Crowfoot.
29 Croſs tree Braces.
30 Mizan Tack.
31 The Laniards.
32 The Mizan Topmaſt Crowfoot.

Main Maſt and running Rigging.

1 Main-maſt & main Topmaſt
2 Main yard and Main Sail.
3 Main Topſail yard and Sail.
4 Topgallant yard and Sail.
5 Topgallant Croſs-trees & Cap
6 Main Lifts.
7 Main Topſail Lifts.
8 Topgallant Lifts.
9 Main Braces.
10 Main Sheets.
11 Main Bowlings.
12 Main Clewgarnets.
13 Main Stay.
14 Main Shrowds. (Plaits.
15 Main Chains and Chain-
16 Backſtays for the main Top: Maſt.
17 Main Topmaſt Stay.
18 Main Topſail Braces.
19 Main Topſail Clewlines.
20 Main Topſail Bowlines
21 Main Topmaſt Shrowds.
22 Main Topgallant Shrowds.
23 Topgallant Clewlines.
24 Topgallant Braces.
25 Topgallant Bowlines.
26 The horſe for the main Topſail yard.
27 Main Topſail Leathlines.
28 Main Topſail Buntlines.
29 A Crowfoot from the Top to the Stay.
30 Main Tacks.
31 Main Sheets. (Garnet.
32 The main Tye and fall of the
33 The Main Horſe & Tackle.
34 The Tye of the main Topſail Jeers.
35 The main Topgallant Sails Tye and Jeers.

Foremaſt & rigging.

1 Foremaſt and Topmaſt.
2 Fore yard and Sail.
3 Fore Topſail yard and Sail.
4 Topgallant yard and Sail.
5 Fore Lifts.
6 Fore Topſail Lifts.
7 Fore Topgallant Lifts.
8 Croſs-trees and Cap.
9 Fore Braces.
10 Fore Topſail Braces.
11 Fore Topgallant Braces.
12 Fore Sheets and Tacks.
13 Fore Bowlines.
14 Fore Topſail Bowlines.
15 Fore Topgallant Bowlines.
16 Fore Clewgarnets.
17 Fore Topſail Clewlines.
18 Fore Shrowds.
19 Fore Topmaſt Shrowds.
20 Fore Topgallant Shrowds.
21 Fore Stay.
22 Fore Topmaſt Stay.
23 Fore Topgallant Stay. (yard
24 Horſe for the fore Topſail
25 Fore Topgallant Clewlines.
26 Fore Topmaſt Backſtaies.
27 Fore Chains and Plaits.
28 Fore Topſail Leathlines.
29 Fore Topſail Buntlines.
30 Fore Leathlines.
31 Fore Buntlines.
32 The Fore Topſails Tye and Jeer.
33 The Yard of the fore Topſail.
34 The Fore Horſe and Tackle.
35 The foretop Gallantſails Tye and Jeer.
36 The Fore Tacks.

The Bowſprit and Rigging.

1 Bowſprit.
2 Spritſail yard and Sail.
3 Spritſail Top and Croſs-trees
4 Spritſail Topſail yard & ſail.
5 Spritſail Topmaſt.
6 Spritſail Sheets. (ſail yard.
7 Standing Lifts for the Sprit-
8 Spritſail Braces.
9 Spritſail Sheets.
10 Spritſail Clewlines.
11 Spritſail Topſail Braces.
12 Spritſail Topſail Lifts.
13 Spritſail Topmaſt Shrowds.
14 Jack Staff and Jack.
15 The Ships Head.
16 The Cat Head.
17 The Harſſes.
18 The fore Caſtle.
19 The Crain line.
20 The Horſe on the Bowſprit.
21 Steps on the ſide.
22 The main Spritſail. (Jeers.
23 The main Spretſail Tye &
24 The Spritſail Topſail Clewlines.
25 The Spritſail Topſails Jeer.
26 The Spritſail Topſail Crow-
27 The Trens Bowſprit. (foot.

925

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THE

SEA-MAN'S Grammar *and* Dictionary,

Explaining all the difficult TERMS in NAVIGATION:

AND THE PRACTICAL

Navigator *and* Gunner:

In Two Parts.

I. Moſt plain and eaſy Directions, to Build, Rigg, Yard, and Maſt any SHIP whatſoever. With the manner of working of a SHIP in all Weathers: ——And how to manage a Fight at Sea: ——Alſo the Charge and Duty of every Officer in a Ship, and their Shares ——— And the uſe of the PETTY-TALLY.

II. An Abſtract of the Art of *GUNNERY*, (or Shooting in great ORDNANCE and MORTER-PIECES): Wherein the Principles of that Art are plainly Taught, both by Arithmetical Calculation, and by TABLES ready Calculated ——With the Compoſitions for the making of ſeveral FIRE-WORKS uſeful in War, both at SEA and LAND. —— And an Apendix how by ſeveral Geometrical Ways to take Heights, Depths, and Diſtances, Acceſſible or Inacceſſible.

By Captain *JOHN SMITH*,

Sometimes Governour of *Virginia*, and Admiral of *New England*.

Now much Amplified and Enlarged, with variety of Experiments, ſince his Time, made by ſeveral Experienced *NAVIGATORS* and *GUNNERS*.

London; Printed for *Richard Mount*, at the *Poſtern* on *Tower-Hill*, 1699.

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JOHN CARTER BROWN

THE PRINTER TO THE READER,

And all worthy Adventurers by Sea, and well wiſhers to

NAVIGATION.

THere hath been much already written concerning the Art of War by Land, but nothing concerning the ſame at Sea; yet perceiving the preſent occaſion to require ſomething of that kind, I have adventured to bring again to remembrance, thoſe excellent Precepts and Directions, long ſince publiſhed by Captain *John Smith*, which were almoſt worn out by time, and herein, if my deſire to do good hath tranſported me beyond my ſelf, I intreat your excuſe, and take for requital this bundle of many Ages Obſervations: which although they be not ſo punctually compiled as the Author could have wiſhed, and it may be you expect, yet at preſent they cannot be much amended; If any will beſtow that pains, I ſhall think him my friend, and honour his endeavours.

And now (ſince it was the deſire of the Experienced Author, to have this his Treatiſe amplified and made more uſeful,) I have, in this Edition, cauſed to be added, *An Alphabetical Table* of the Names of all the Parts

or

or Members of a *Ship*, and its *Apurtenances*; with the number of the Page wherein they are at large Explained: And alſo, another *Alphabetical Table*, wherein the principal *Sea-Terms* uſed in working of a *Ship* in all *Winds* and *Weathers*, and alſo in a *Fight* at Sea, are largely diſcourſed and explained.

And to make this Treatiſe, yet more uſeful for Sea-ſervice (eſpecially in time of War) I have cauſed to be added alſo, an *Abſtract* of the Art of *Practical Gunnery*; Wherein the Principles of that Art are plainly Taught both by *Arithmetical Calculation*, and by new *Tables* ready *Calculated*. Together with the manner of Shooting in *Morter-Pieces*; The making of *Granados*, *Petards* and other *Fireworks* uſeful in War, both at Sea and Land: And by way of *Appendix*, ſeveral *Geometrical* ways, to take *Heights*, *Depths*, and *Diſtances*, acceſſible or inacceſſible. All which are freely communicated for the benefit of his Country, and the good of Navigators and Gunners:

And as I ſhall find theſe Eſſays of mine accepted, I ſhall be encouraged farther to accommodate them with the Mathematical part of *Navigation*.

B. N.

THE CONTENTS *Of the* Grammar.

Folio

OF Docks and their definitions, and what belongs to them, *Chap.* 1. 1

How to build a Ship, with the definition of all the principal names of every part of her, and her principal timbers, also how they are fixed one to another, and the reasons of their use. *Chap.* 2. 2

How to proportion the Masts and Yards for a Ship, by her Beam and Keel *Ch.* 3. 15

The names of all the Masts, Tops and Yards belonging to a Ship. *Chap.* 4. 17

How all the Tackling and Rigging of a Ship is made fast one to another, with the Names and Reasons of their use. *Chap.* 5. 18

What doth belong to the Boats and Skiff, with the definition of all those thirteen Ropes, which are only properly called Ropes belonging to a Ship or a Boat, and their use. *Chap.* 6. 26

The names of all sorts of Anchors, Cables and Sails, and how they bear their proportions, with their use. Also how the Ordnance should be placed, and the Goods stowed in a Ship. *Chap.* 7. 29

The charge and duty of the Captain of a Ship, and every Office and Officer in a man of War. *Chap.* 8. 34

Proper Sea-terms for dividing the Company at Sea, and steering, sailing and moaring a Ship in fair weather or in a storm. *Chap.* 9. 37

Proper Sea terms for the Winds, Ebbs, Floods, and Eddies, with their definitions, and an estimate of the depth of the Sea, by the height of the Hills and largeness of the Earth. *Chap.* 10. 46

Proper Sea-terms belonging to the good or bad condition of Ships, how to find them and amend them. *Chap.* 11. 52

Considerations for a Sea-Captain in the choice of his Ship, and in placing his Ordnance: In giving Chase, Boarding, and entring a man of War like himself, or defending a Merchant-man. *Chap.* 12. 54

How

The Contents of the Grammar.

How to manage a Fight at Sea, with the proper terms in a Fight largely expreſſed, and the ordering a Navy at Sea. *Chap.* 13. 59

How they divide their ſhares in a man of War, what Books and Inſtruments are fit for a Sea-man, with divers advertiſements for young Gentlemen that intend to follow the Sea, and the uſe of the Petty Tally. *Chap.* 14. 63

An Alphabetical Table of the Names of all the Parts or Members of a Ship, and its Appurtenances, with the Number of the Page in which the Term, (or Word) there form'd, is Explained at Large. *Chap.* 15 67

Another Alphabetical Table, Explaining all the Principal Sea Terms uſed in work of a Ship, in all Winds and Weathers. *Chap.* 16. 74

The

THE CONTENTS *Of* Gunnery.

Folio

WHerein is declared the Names of all ſorts of Ordnance, and their Appurtenances, with an Explanation of their proper Terms; and divers Obſervations concerning Shooting in them. *Chap.* 1. 85

How a Gunner ought to be Qualified. *Chap.* 2. 90

Of ſuch Neceſſary Implements and Inſtruments as a Gunner that hath charge of Guns or Artillery ought to be furniſhed with. *Chap.* 3. 91

Cautions that a Gunner ought to obſerve before he fire his Gun. *Chap.* 4. 92

Of Gunpowder, and how it hath been made from time to time, and how it is made at this preſent. *Chap.* 5. 93

Of the Names of the ſeveral parts or members of a Piece of Ordnance *Chap.* 6. 93

Of the ſeveral Pieces of Ordnance now in uſe. *Chap.* 7. 95

How to find the Diameter of any Round Shot or Bullet, by knowing the Circumference: Or, By having the Circumference of a Shot, to find the Diameter. *Chap.* 8. 97

A Table ſhewing how to find the Diameter of any Circle or Ring of a Gun not exceeding 54 Inches: Of excellent uſe for the eaſie and exact finding of the length of the Diſpart of any Gun: As alſo of the Diameter of any Shot or Bullet: without Callopers, and alſo of Granado-Shells. *Chap.* 9. 100

Concerning the Diſparting of any Piece of Ordnance, and how to find the length of the Diſpart. *Chap.* 10. 103

How to know whether a Piece of Ordnance be truly bored or not, when it is in its Carriage: and lying Horizontally. *Chap.* 11. 106

Concerning Guns that are not truly bored; How to know what quantity of Powder muſt be allowed for their Loading. *Chap.* 12. 108

How to diſcover what Cracks, Flaws, or Honeycombs are in any Piece of Ordnance. *Chap.* 13. 109

Concerning the Weight of Iron ſhot, and Granado-ſhels. *Chap.* 14. 110

Concerning the following Table of Cube-Roots, *Chap.* 15. 114

Concerning

The Contents of Gunnery.

Concerning the Proportion of the Weights of Iron, Lead, Stone, *&c.* And how by knowing the Weight of one Shot of Lead, to find the Weight of another of the like Diameter of Iron or Stone. *Chap.* 16. 124

Concerning Gunpowder, and to find what quantity will fill any Granado-Shell or Cartridge. *Chap.* 17. 126

Concerning the Allowance of Powder for the Charge of any well Fortified Gun either Brass or Iron, according to the Weight thereof, from one hundred to ninety hundred Weight of Metal. *Chap.* 18. 128

Concerning Cartridges, how to make them, and fit them, fitting for the Bore, or Chamber of any Piece of Ordnance. *Chap.* 19. 130

Concerning Carriages for Pieces of Ordnance, and how they should be made. *Chap.* 20. 133

Concerning Shooting in great Ordnance, and how to Load your Gun Artificially, either with Powder or Cartredge. *Chap.* 21. 134

How to give Level with a Piece of Ordnance to make a Shot at any mark within Point blank. *Chap.* 22. 135

Shewing how to amend a Shot, which (by some accident) doth carry over, under, or wide of the Mark intended. *Chap.* 23. 135

Concerning a Gunner's Ruler, for the Elevating of any Piece of Ordnance to any degree of Mounture, supplying the use of the Gunner's Quadrant. *Chap.* 24 129

A Table, and the Use thereof, whereby you may give Level to a Piece of Ordnance, without the Gunners Rule or Quadrant, to any degree of Mounture under eleven degrees. *Chap.* 25 133

Concerning Shooting at Randon. *Chap.* 26. 135

How you may make a good at your Enemies Light in a dark night. *Chap.* 27. 139

How to make a perfect Shot in a dark night, at any mark (within the reach of the Piece) that you can see in the day time. *Chap.* 28. 139

How to make a good Shot at a Company of Souldiers passing by; or at a Ship sailing up a River. *Chap.* 29. 140

Some Reasons, Why one and the same Piece of Ordnance at the same Elevation, charged with the same quantity of Powder, and directed to the self same Mark, and discharged several times, shall have different Rainges. *Chap.* 30. 140

Concerning Shooting in a Morter-Piece, and of several Fire-Works, both for Sea and Land Service. *Chap.* 31. 142

The Measuring of Heights, Depths, and Distances, *&c.* 152

The

THE SEA-MANS GRAMMAR and DICTIONARY; OR THE PRACTICAL NAVIGATOR and GUNNER.

In Two Books

CHAP. I.

Of Docks, *and their definitions.*

A DOCK is a great pit or pond, or Creek by a Harbour ſide, made convenient to work in, with two great flood gates built ſo ſtrong and cloſe, that the Dock may be dry till the ſhip be built or repaired, and then being opened, let in the water to float and lanch her, and this is called a **Dry-Dock**. A **Wet-Dock** is any place where you may hale in a ſhip into the oze out of the tides way, where ſhe may dock her ſelf. A **Cradle** is a frame of timber, made along a ſhip, or the ſide of a Galley by her billidge, for the more eaſe and ſafety in lanching, much uſed in *Turky*, *Spain*, and *Italy*. And the **Stockes** are certain

A dry-Dock.

A wet-Dock.

A Cradle.

The Stockes.

certain framed posts, much of the same nature upon the shore to build a Pinnace, a Catch, a Frigat, or Boat, *&c.* To those Docks for building belongs their Wood-yards, with Saw-pits and all sorts of timber; but the Masts and Yards are chained together in some greater water to keep them from rotting, and in season: Also a **Crab** is necessary, which is an Engine of wood of three claws placed on the ground in the nature of a Capstern, for the lanching of ships or heaving them into the Dock.

Crab.

CHAP. II.

How to build a Ship, with the definitions of the names of every part of her Principal Timbers, *and how they are fixed one to another, with the reasons of their use.*

The Keel.

THe first and lowest Timber in a ship is the **Keel**, to which is fastened all the rest; this is a great tree or more, hewn to the proportion of her burden, laid by a right line in the bottom of the Dock, or Stocks. At the one end is Skarfed into it the **Stem**, which is a great timber wrought compassing, and all the butt-ends of the planks forwards are fixed to it. The **Stern post** is another great Timber, which is let into the Keel at the other end somewhat sloping, and from it doth rise the two **fashion-pieces** like a pair of great horns, to those are fastened all the planks that reach to the after end of the Ship, but before you use any planks, they lay the **Rungs**, called floor timbers, or ground timbers, thwart the keel: thro' those you cut your **Limberholes** to bring the water to the well for the pump, the use of them is when the Ship is built to draw in them a long hair rope, by pulling it from Stern to Stem, to scowre them, and keep them clean from choaking.

The Stem.

The Stern.

The fashion-pieces.

The Rungs.

The Limber-holes.

Those

Thoſe ground timbers do give the **Floor** of the Ship, being ſtraight, ſaving at the ends they begin to compaſs, and there they are called the **Rungheads**, and doth direct the **Sweep** or **Mould** of the Foot-hooks and Navel timbers, for there doth begin the compaſs and bearing of the Ship, thoſe are **Skarfed** into the ground Timbers, which is one piece of wood let into another, or ſo much wood cut away from the one as from the other, for when any of thoſe Timbers are not long enough of themſelves, they are skarfed in this manner, to make two or three as one: Thoſe next the Keel are called the ground Foot-hooks, the other the upper Foot-hooks; but firſt lay your **Keelſon** over your floor Timbers, which is another long tree like the **Keel**, and this lying within as the other without, muſt be faſt bound together with ſtrong iron bolts thorow the Timbers and all, and on thoſe are all the upper works raiſed, when the **Foot-hooks** are skarfed as is ſaid, and well boulted, when they are planked up to the Orlop they make the Ship **Howle**, and thoſe Timbers in general are called the Ships **Ribs**, becauſe they repreſent the carkaſs of any thing that hath Ribs. The **Sleepers** run before and after one each ſide the Keelſon, on the floor well bolted to the Foot-hooks, which being thus bound do ſtrengthen each other. The **Spurkits** are the ſpaces betwixt the Timbers alongſt the Ship ſide in all parts, but them in Howle below the Sleepers, are broad boards which they take up to clear the Spurkits, if any thing get betwixt the Timbers.

The Floor.
Rungheads.
Sweep.
Mould.
Skarfing.
Foot-hooks.
Keelſon.
Howle.
Ribs.
Sleepers.
Spurkits.

The **Garboard** is the firſt plank next the Keel on the outſide, the **Garboard-Strake** is the firſt ſeam next the Keel, your **Riſing timbers** are the hooks, or ground timbers and foot-hooks placed on the Keel, and as they riſe by little and little, ſo doth the **Run** of the Ship from the floor, which is that part of the Ship under water, which comes narrower by degrees from the floor timbers along the ſtern poſt, called the Ships way afterward, for according to her run ſhe will ſtear well or ill, by reaſon of the quickneſs or flowneſs of the water coming to the Rudder; Now all thoſe

The Garboard
Garbord-ſtrak.
Riſing-timbers.
The Run.

Planks. planks under water, as they riſe and are joyned one end to another, the fore end is called the **But-end** in all Ships: but in great Ships they are commonly moſt carefully bolted, for if one of thoſe ends ſhould ſpring, or give way, it would be a great troubleſome danger to ſtop ſuch a leak, the other parts of thoſe planks are made faſt with good **Tree nails** and **Trunnions** of well ſeaſoned Timber, thorow the Timbers or Ribs, but thoſe planks that are faſtened into the Ship ſtern are called **Whoodings.**

But-ends.

Tree-nails.

Trunnions.

Whoodings.

The Tuck. The gathering of thoſe works upon the Ships quarter under water is called the **Tuck**, if it lie too low it makes her have a fat quarter, and hinders the quick paſſage of the water to the Rudder; if too high, ſhe muſt be laid out in that part, elſe ſhe will want bearing for her after-works. The **Tranſome** is a Timber lies thwart the ſtern, betwixt the two faſhion-pieces, and doth lay out the breadth of the Ship at the **Buttocks**, which is her breadth from the Tuck upwards, and according thereto her breadth or narrowneſs, we ſay ſhe hath a narrow or broad Buttock: The faſhion-pieces before ſpoken of, are the two outmoſt timbers on either ſide the ſtern, excepting the **Counters**. The Ships **Rake** is ſo much of her **Hull** as hangs over both ends of the Keell, ſo much as is forward is ſaid, ſhe rakes ſo much forward, and ſo in like manner aftward; by the Hull is meant, the full bulk or body of a Ship without maſts or any rigging from the Stem to the Stern: The Rake forward is near half the length of the Keell, and for the Rake aftward about the forepart of her Rake forward, but the fore Rake is that which gives the Ship good way, and makes her keep a good wind, but if ſhe have not a full Bow, it will make her pitch her head much into the Sea; if but a ſmall Rake forward, the Sea will meet her ſo faſt upon the Lowes, ſhe will make ſmall way, and if her Stern be upright as it were, ſhe is called **Bluffe**, or **Bluff-headed**. A Ship **Billage** is the breadth of the floor when ſhe doth lie aground, and Billage-water is that which cannot come to the pump, we ſay alſo ſhe is bilged when ſhe ſtrikes on a Rock, an Anchors Floor, or any thing

Tranſome.

Buttocks.

Rake.

The Hull.

Bluffe.

Bluffe-headed

Billage.

thing that breaks her Planks or Timbers to ſpring a Leak.

When you have berthed or brought her up to the **Planks**, which are thoſe thick Timbers which goeth fore and aft on each ſide, whereon doth lie the beams of the firſt **Orlop**, which is the firſt floor to ſupport the Planks, doth cover the Howle, thoſe are great croſs-timbers, that keeps the Ships-ſides aſunder, the main beam is ever next the main Maſt, where is the Ships greateſt breadth, the reſt from this is called the firſt, ſecond, third, fourth, *&c.* forward or aftward Beams. Great Ships have a tire of Beams under the Orlop, whereon lies no Deck, and great poſts and binders called **Riders** from them to the Keel in Howle only to ſtrengthen all. But the beams of the Orlop is to be bound at each end with ſufficient **Knees** which is a crooked piece of wood bowed like a Knee, that binds the Beams and Foot-hooks, being bolted together, ſome ſtand right up and down, ſome along the Ship, and are uſed about all the Decks, ſome ſawed or hewed to that proportion, but them which grow naturally to that faſhion are the beſt.

Planks.

Orlop-Beams.

Riders.

Knees.

Lay the Orlop with good Plank, according to her proportion, ſo level as may be, is the beſt in a Man of War, becauſe all the **Ports** may be of ſuch equal height, ſo that every Piece may ſerve any Port, without making any **Beds** or Platforms to raiſe them, but firſt bring up your work as before to the ſecond Deck or Orlop, and by the way you may cut your number of Port-holes according to the greatneſs of your Ship; by them faſten your **Ring-bolts**, for the Tackles of your Ordnance you uſe Ringbolts alſo for bringing the Planks and Walls to the Ship ſide, and **Set-bolts** for forcing the Works and Planks together: **Clinch-bolts** are clinched with a riveting hammer for drawing out. But **Rag-bolts** are ſo jaggered that they cannot be drawn out. **Fore-lock-bolts** hath an eye at the end, whereinto a Fore-lock of Iron is driven to keep it from ſtarting back. **Fend-bolds** are beat into the outſide of a Ship, with the long head to ſave her ſides from galling againſt other Ships. **Drive-bolts** is a long piece of Iron to drive out a Tree-nail, or any

Ports.

Beds.

Ring-bolts.

Set-bolts.

Clinch-bolts.

Rag-bolts.

Forelock-bolts.

Fend-bolts.

Drive-bolts.

ſuch things, beſides divers others ſo uſeful that without them and long Iron-ſpikes and Nails nothing can be well done; yet I have known a Ship built, hath ſailed to and again over the main Ocean, which had not ſo much as a Nail of Iron in her, but only one Bolt in her Keel.

She was built of Cedar.

Clamps.

Now your riſings are above the firſt Orlop as the **Clamps** are under it, which is long thick Planks like them, fore and aft on both ſides, under the ends of the Beams and Timbers of the ſecond Deck or Orlop, or the third Deck or Orlop, or the third Deck which is never called by the name of Orlop, and yet they are all but Decks; alſo the **half-Deck** and **Quarter-Deck**, whereon the Beams and Timbers bear, are called riſings. A **flush Deck** is when from Stem to Stern, it lies upon a right line fore and aft, which is the beſt for a Man of War, both for the men to help and ſuccour one another as for the uſing of their arms, or remounting any diſmounted Piece, becauſe all the Ports on that Deck are on equal height, which cannot be without Beds and much trouble, where the **Deck doth camber** or lie compaſſing. To **ſink a Deck** is a to lay it lower, to **raiſe a Deck** to put it higher, but have a care you ſo cut your Port-holes, that one piece lie not right over another for the better bringing them to your mark.

Decks.
A half Deck.
A Quarter-Deck.
A flush Deck.

A Cambered Deck.
To ſink a Deck
To raiſe a Deck.

The half Deck is from the main Maſt to the Steerage, and the Quarter-Deck from that to the Maſters Cabin called the Round Houſe, which is the utmoſt of all, but you muſt underſtand all thoſe Works are brought up together, as near equally as may be from **bend** to **bend**, or **waile** to **waile**, which are the outmoſt Timbers on the Ship-ſides, and are the chief ſtrength of her ſides, to which the Foot-hooks, Beams and Knees, are bolted, and are called the firſt, ſecond, and third Bend; but the **Chain-waile** is a broad timber ſet out amongſt them, a little above where the Chains and Shrouds are faſtned together, to ſpread the Shrouds the wider, the better to ſuccour the Maſts. Thus the Sides and Decks are wrought till you come at the **Gun-waile**, which is the upmoſt waile, goeth about the upmoſt ſtrake or ſeame of the upmoſt Deck about the **Ships waſte**, and the **Ships Quarter** is from the main Maſt aftward.

Bend, or waile.

Chain-waile.

Gun-waile.

The Ships Quarters.

Cul-

Culver-tailed is letting one Timber into another, in such sort that they cannot slip out, as the **Carling** ends are fixed in the Beams, and Carlings are certain Timbers lieth along the Ship from beam to beam, on those the ledges do rest, whereunto the Planks of the Decks are fastened. The **Carling-knees** are also timbers comes thwart the Ship from the sides of the Hatches way, betwixt the two Masts, and bears up the Deck on both sides, and on their ends lieth the **commings** of the Hatches, which are those Timbers and Planks which bears them up higher than the Decks, to keep the water from running down at the Hatches; also they fit **Loope-holes** in them for the close fights, and they are likewise a great ease for men to stand upright if the Decks be low. The **Hatches way** is when they are open where the Goods are lowered that way right-down into the **howle**, and the **Hatches** are like Trap doors in the midst of the Decks, before the Main-Mast, by certain Rings, to take up or lay down at your pleasure.

Culver-tailed, Carlings. Carling-knees. Commings. Loopholes. Hatches way.

A **Scuttle hatch** is a little Hatch doth cover a little Square-hole we call the Scuttle, where but one man alone can go down into the Ship; they are in divers places of the Ship whereby men pass from Deck to Deck, and there is also small Scuttles Grated, to give light to them betwixt Decks, and for the smoak of the Ordnance to pass away by. The **Ramshead** is a great Block wherein is three shivers, into which are passed the Halyards, and at the end of it in a hole is reved the ties, and this is only belonging to the fore-end Main Halyard; to this belong the **fore-knight**, and the **main-knight**, upon the second Deck fast bolted to the Beams. They are two short thick pieces of wood, commonly carved with the head of a man upon them, in those are four shivers apiece, three for the Halyards, and one for the top-rope to run in: and **knevels** are small pieces of Wood nailed to the inside of the Ship, to belay the Sheats and Racks unto.

A Scuttle. Ramshead. The fore-Knight, The main-Knight. Knevels.

The **Capstaine** is a great piece of Wood, stands upright upon the Deck, abaft the main Mast, the foot standing in a step

Capstaine.

ſtep upon the lower Deck, and is in the nature of a Windis, to wind or weigh up the Anchors, Sails, Tap-maſts, Ordnance, or any thing ; it is framed in divers Squares, with holes thorow them, thorow which you put your **Capſtain Bars**, for as many men as can ſtand at them to thruſt it about, and is called manning the Capſtain. The main body of it is called the **Spindle.** The **Whelps** are ſhort pieces of wood made faſt to it; to keep the Cable from coming too high in the turning about. The **Paul** is a ſhort piece of Iron made faſt to the Deck, reſting upon the Whelps to keep the Capſtain from recoiling, which is dangerous, but in great Ships they have two, the other ſtanding in the ſame manner betwixt the fore-maſt and the main, to heave upon the Jeare-rope, and is called the **Jeare Capſtain**, to ſtrain any Rope, or hold off by, when we weigh Anchor, to heave a head, or upon the Viol, which is when an Anchor is in ſtiff ground we cannot weigh it, or the Sea goeth ſo high the main Capſtain cannot purchaſe in the Cable, then we take a Hawſer opening one end, and ſo puts into it Nippers ſome ſeven or eight fathom diſtant from each other, wherwith we bind the Hawſer to the Cable, and ſo brings it to the Jeare Capſtain to heave upon it, and this will purchaſe more than the main Capſtain can. The **Viol** is faſtened together at both ends with an eye or two, with a Wall-knot, and ſeaſed together. A **Windas** is a Square-piece of Timber like a Role before the fore Caſtle in ſmall Ships, and forced about with handſpikes, for the ſame uſe as is the Capſtain.

Capſtain-Bars.

The Spindle.
Whelps.

Paul.

Jeare Capſtain

The Viol.

A Windas.

What are the parts of a **Pump** you may ſee in every place, the handle we call the **Brake**, the Pumps **Can** is a great **Can** we pour water into Pumps to make it pump. The **Daile** is a Trough wherein the water doth run over the Docks: But in great Ships they uſe **chained Pumps** which will go with more eaſe, and deliver more water. The *Dutch* men uſe a **Burre Pump** by the Ship-ſide, wherein is only a long ſtaffe with a Burre at the end, like a Gunners Spunge, to pump up the Billage water, that by reaſon of the breadth of the Ships floor cannot come to the Well: In pumping

The Pump.
The Brake.
The Can.

The Daile.
Chained.
Pumps.

A Bur-Pump.

pumping they uſe to take ſpels, that is, freſh men to relieve them, and count how many ſtrokes they pump each watch, whereby they know if the Ship be ſtanch, or tight, or how her Leaks increaſe. The **Pump ſucks** is when the water being out, it draws up nothing but froth and wind. They have alſo a little Pump made of a Cane, a little piece of hollow wood or Latten like an Elder gun, called a **Bare Pump**, to Pump the Beer or Water out of the Cask, for at Sea we uſe no Taps, and then ſtave the Cask to make more room, and packeth the Pipe-ſtaves or boards up as cloſe as may be in other Cask till they uſe them. The Pump-ſuck. A Bare-Pump.

The **Skuppers** are little holes cloſe to all the Decks thorow the Ships ſides, whereat the water doth run out when you pump or waſh the Decks: the **Skupper-leathers** are nailed over thoſe holes upon the lower Deck to keep out the Sea from coming in, yet give they way for it to run out: **Skupper-nails** are little ſhort ones with broad heads, made purpoſely to nail the Skupper-leathers, and the cores of Maſts and Pumps. The **Waiſt** is that part of the Ship betwixt the main Maſt and the Fore-caſtle, and the **Waiſt-boards** are ſet up in the Ships Waiſt, betwixt the Gun-waile and the **Waiſt-trees**, but they are moſt uſed in Boats, ſet up alongſt their ſides to keep the Sea from breaking in. The Skupper. Skupper-leathers. Skupper-nails. The Waiſt. Waiſt-boards. Waiſt-trees.

There are uſually three **Ladders** in a Ship: the **entering Ladder** is in the Waiſt, made formally of wood, and another out of the **Gallery** made of Ropes to go into the Boat by in foul weather, and the third at the Beak-head, made faſt over the **Boultſpret** to get upon it, only uſed in great Ships. The entering-Ladder. Gallery-Ladder. Boultſpret-Ladder.

It were not amiſs now to remember the **Fore-caſtle**, being as uſeful a place as the reſt, this is the forepart of the Ship above the Decks over the **Bowe**, there is a broad Bowe and a narrow Bowe, ſo called according to the broadneſs or the thinneſs: the Bowe is the broadeſt part of the Ship before, compaſſing the Stem to the **Louſe**, which reacheth ſo far as the Bulk head of the Fore caſtle extendeth. Againſt the The Fore-caſtle. Bowe. Louſe.

Cut a Feather. Bowe is the firſt breach of the Sea, if the Bowe be too broad, ſhe will ſeldom carry a bone in her mouth, or **cut a feather**, that is, to make a ſome before her: where a well bowed Ship ſo ſwiftly preſſeth the water, as that it foameth, and in the dark night ſparkleth like fire. If the Bowe be too narrow, as before is ſaid, ſhe pitcheth her head into the Sea, ſo that the mean is the beſt if her after-way be anſwerable. The

Hauſes. **Hauſes** are thoſe great round holes before, under the Beak-head, where commonly is uſed the Caſtles when you come to an Anchor, the bold or high Hauſe is the beſt, for when they lie low in any great Sea, they will take in very much water, the which to keep out, they build a circle of Plank

Manger. either abaft or before the main Maſt called the **Manger**: and a Hauſe-plug at Sea, now the Fore-caſtle doth cover all thoſe being built up like a half Deck, to which is fixed

Prow. the Beak-head, and the **Prow** is the Deck abaft the fore-caſtle, whereon lieth the Prow pieces.

The Beak-head. The **Beak head** is without the Ship before the fore-Caſtle, ſupported by the main knee, faſtened into the Stem, all painted and carved as the Stern, and of great uſe, as well for the grace and countenance of the Ship, as a place for men to eaſe themſelves in. To it is faſtened the Coller of the main ſtay, and the fore tacks there brought aboard: alſo the ſtanding for rigging and trimming the Sprete-ſail-

Combe. geare, under the midſt of it is the **Comb**, which is a little piece of wood with two holes in it to bring the fore tacks

Bits. aboard. The **Bits** are two great pieces of Timber, and the

Croſpiece. **Croſpiece** goeth thorough them, they are ordinarily placed abaft the Manger in the Ships looſe, to belay the Cable thereto when you ride at Anchor: Their lower parts are faſtened to the Riders, but the middle part in great Ships are bolted to two great Beams croſs to the Bowes, and yet in extraordinary ſtorms we are glad to make faſt the Cable to the main Maſt for ſtrengthening of the Bits and faſeip of the Bowes, which have in great ſtorms been torne from

David. the Ships. The **David** is a ſhort piece of Timber, at the end whereof in a notch they hang a block in a ſtrap called the

Fiſh-

Fish-block, by which they hale up the flook of the Anchor to the Ships Bowe, it is put out betwixt the Cat and the Loofe, and to be removed when you please. The **Cat** is also a short piece of timber aloft, right over the Hause; in the end it hath two shivers in a block, wherein is reaved a Rope, to which is fastened a great hook of Iron, to trice up the Anchor from the Hause to the top of the Fore-castle. Fish-block. Cat.

A **Bulks-head** is like a seeling or a wall of boards thwart the Ship, as the Gun-room, the great Cabin, the bread room, the quarter-Deck, or any other such division; but them which doth make close the Fore-castle, and the half-Deck, the Marriners call the **Cubbridge-heads**, wherein are placed murtherers, and abaft Falcons, Falconets, or Robinits to clear the Decks fore and aft so well as upon the Ships sides, to defend the Ship and offend an enemy. **Sockets** are the holes wherein the Pintels of the Murderers or Fowlers go into. The hollow Arching betwixt the lower part of the Gallery and the Transome, is called the **lower Counter**; the **upper Counter** is from the Gallery to the Arch of the round House, and the **Brackets** are little carved Knees to support the Galleries. A Bulk-head. Cubbridge-head. Sockets. Low Counter. Upper Counter Brackets.

The **Stearage** room, is before the **great Cabin**, where he that steareth the Ship doth always stand, before him is a square Box nailed together with Wooden Pins, called a **Bittacle**, because Iron-nails would attract the Compass, this is built so close, that the Lamp or Candle only sheweth light to the Stearage, and in it always stands the **Compass**; which every one knows is a round Box, and in the midst of the bottom a sharp Pin called a Centre whereon the Fly doth play, which is a round piece of Past-board, with a small wyer under it touched with the Load-stone, in the midst of it is a little brass Cap that doth keep it level upon the Center. On the upper part is painted 32 points of the Compass covered with Glass to keep it from dust, breaking, or the wind; this Box doth hang in two or three brass Circles, so fixed they give such way to the moving of the Ship that still the Box will stand steady; there is also a **dark Com-** The Stearage. Great Cabin. Bittacle. The Compass.

A dark Compaſs. A Compaſs for Variation. The Travas.

paſs, and a **Compaſs** for the **variation**, yet they are but as the other, only the dark Compaſs hath the Points black and white, and the other only touched for the true North and South. Upon the **Bittacle** is alſo the **Travas**, which is a little round board full of holes upon Lines like the Compaſs, upon which by the removing of a little ſtick they keep an account, how many Glaſſes (which are but half-hours) they ſteer upon every point. The **Whip-ſtaffe** is that piece of wood like a ſtrong ſtaffe the Steerſman or Helmſmen hath always in his hand going thorough the **Howl**, and then made faſt to the Tiller with a Ring.

The Whip-ſtaffe.

The Rowle.

The Tiller. Rudder.

The **Tiller** is a ſtrong piece of wood made faſt to the **Rudder**, which is a great timber ſomewhat like a Plank, made according to the burthen of the Ship, and hung at the Stern upon Hooks and Hinges, they call **Pintels** and **Gudgions**, or **Rudder-irons**. The Tiller playeth in the **Gun room** over the Ordnances by the Whip-ſtaff; whereby the Rudder is ſo turned to and fro as the Helmeſman pleaſeth, and the **Cat-holes** are over the Ports, right with the Capſtain as they can, to heave the Ship a ſtern by a Cable or a Hauſer called a Stern-faſt. On each ſide the Steerage-room are divers Cabins, as alſo in the great Cabin, the quarter Deck, and the Round-houſe, with many convenient Seats or **Lockers** to put any thing in, as in little Cupboards.

Pintels. Gudgions, or Rudder-Irons. The Gun-room. Cat-holes.

Lockers.

The Bread-room. Cook-room.

The **Bread-room** is commonly under the Gun-room, well dried or plated. The **Cook room** where they dreſs their Victuals may be placed in divers places of the Ship, as ſometimes in the Hould, but that oft ſpoileth the victuals by reaſon of the heat, but commonly in Merchant-men it is the Fore-caſtle, eſpecially being contrived in Furnaces; beſides in chaſe their **Stern** is that part of the Ship they moſt uſe in fight, but in a Man of War they fight moſt with their Prow, and it is very troubleſome to the uſe of his Ordnance, and very dangerous lying over the Powder room, ſome do place it over the Hatches way, but that as the Stewards room are ever to be contrived according

Stern.

to

to the Ships imployment, &c. **Calking** is beating **Okum** into every ſeam or betwixt Plank, and Plank, and **Okum** is old Ropes torn in pieces like Towze Match, or Hurds of Flax, which being cloſe beat into every ſeam with a **Calking-Iron** and a Mallet, which is a hammer of wood and an Iron chiſſel, being well **Payed** over with hot pitch, doth make her more tight then it is poſſible by joyning Plank to Plank. **Graving** is only under water, a white mixture of Tallow, Sope and Brimſtone; or Train-oil, Roſin, and Brimſtone boiled together, is the beſt to preſerve her calking, and make her glib or ſlippery to paſs the water; and when it is decayed by weeds, or **Barnacles**, which is a kind of fiſh like a long red worm, will eat thorow all the Planks if ſhe be not ſheathed, which is as caſing the Hull under water with Tar, and Haire, cloſe covered over with thin boords faſt nailed to the Hull, which though the Worm pierce, ſhe cannot endure the Tar; **Breaming** her, is but waſhing, or burning of all the filth with reeds or broom, either in a dry-dock or upon her **Careene**; which is, to make her ſo light as you may bring her to lie on the one ſide ſo much as may be in the calmeſt water you can, but take heed you overſet her not; and this is the beſt way to breame Ships of great Burthen, or thoſe have but fourſharp Flores for fear of bruſing or overſetting **Parſling** is moſt uſed upon the Decks and half Decks; which is, to take a liſt of Canvas ſo long as the ſeam is you would parſle, being firſt well calked, then pour hot pitch upon it, and it will keep out the water from paſſing the ſeams. There remains nothing now as I can remember to the building the Hull of the Ship, nor the definition of her moſt proper terms, but only ſeeling the Cabins and ſuch other parts as you pleaſe, and to bind an end with all things fitting for the Sea, as you may read in the Covenants betwixt the Carpenter and the Owner, which are thus;

Calking. Okum. Calking-Iron. Paying. Graving. Barnacles, or Wormes. Broming or Breaming. Carcene. Parſling.

If you would have a Ship built of 400 Tuns, ſhe requires a plank of 4 inches: if 300 Tuns, 3 inches: ſmall Ships 2 inches, but none leſs. For clamps, middle bands, and ſleepers,

pers, they be all of six inch plank for binding within. The rest for the sparring up of the works of square three inch plank. Lay the beams of the Orlope, if she be 400 Tuns at ten foot deep in howle, and all the beams to be bound with two knees at each end, and a stardard knee at every beams end upon the Orlope, all the Orlope to be laid with square three inch plank, and all the planks to be tree-nailed to the beams.

Six foot should be between the beams of the Deck and Orlope, and ten ports on each side upon the lower Orlope, all the binding between them should be with three inch or two inch-plank, and the upper Deck should be laid with so many beams as are fitting, with knees to bind them, laying that Deck with spruce Deal of thirty foot long; the sap cut of, and two inches thick, for it is better then, any other.

Then for the Captains Cabin or great Cabin, the Steerage, the half Deck, the Round-house, the Fore-castle, and to bind an end with the Capstern and all things fitting for the Sea, the Smiths work, the carving, joyning, and painting excepted, are the principal things I remembred to be observed: for a *Charter-party* betwixt the Merchant, the Master, and the Owner, you have Presidents of all sorts in most Scriveners shops.

CHAP.

CHAP. III.

How to proportion the Masts *and* Yards, *for a Ship, by her* Beam *and* Keel.

WHen a Ship is built, she should be masted, wherein is a great deal of experience to be used so well as art; for if you **Over masse** her, either in length or bigness, she will lie too much down by a wind, and labour too much a hull, and that is called a **Taunt-mast**, but if either too small or too short, she is **Under-masted** or low-masted, and cannot bear so great a sail as should give her her true way. For a man of war, a well ordered Taunt-mast is best, but for a long voyage, a short-mast will bear more Canvas, and is less subject to bear by the board: Their Rules are divers, because no Artist can build a Ship so truly to proportion, neither set her Masts, but by the trial of her condition, they may be impaired or amended: suppose a Ship of 300 Tuns be 29 foot at the Beam, if her main mast be 24 inches diameter, the length of it must be 24 yards, for every inch in thickness is allowed a yard in length, and the fore-mast 22 inches in thickness, must be 22 yards in length; your Bowle-spret both in length and thickness must be equal to the fore-mast, the Misen 17 yards in length, and 17 inches diameter.

A Ship over-masted.

Taunt-masted.
Under-masted.

An example.

But the **Rule** most used is to take the $\frac{4}{5}$ parts of the breadth of the Ship, and multiply that by three, it will give you so many foot as your **Main-mast** should be in length, the bigness or thickness will bear it also, allowing an inch for a yard; but if it be **A made-mast**, or **arme-mast**, that is greater than one Tree, it must be more; for example, suppose the Ships breadth 30 foot, four fifths of 30 foot are 24 foot, so you find the main Mast must be 24 yards long, for every yard is 3 foot 24 inches thorow, allowing an inch to every

The rule most used.

A made Mast, or an arme Mast.

every yard. The fore-Maſt is to be in length ⅘ of the main Maſt, which will be 20 yards wanting one ⅘ part of a yard, and 20 inches thorow. The Boultſpret muſt ever be equal with the fore-Maſt. The Miſen-Maſt half the length of the Main-Maſt, which will be 12 yards long, and 12 inches diameter. Now as you take the proportion of the Maſt from the Beam or breadth of the Ship, ſo do you the length of the yards from the Keel.

The Steps. Partners.

Theſe Maſts have each their **Steps** in the Ship, and their **Partners** at every Dock where thorow they paſs to the Keel, being ſtrong Timbers bolted to the Beams in circling the Maſts, to keep them ſteady in their ſteps faſt wedged for rowing; yet ſome Ships will not ſail ſo well as when it doth play a little, but that is very dangerous in foul weather.

Cotes. Tarpawling.

Their **Cotes** are pieces of tarred Canvas, or a **Tarpawling** put about them and the Rudder to keep the water out.

Cheeks.

At the top of the fore Maſt and main-Maſt are ſpliced **Cheeks**, or thick clamps of wood, thorow which are in each two

The Hounds.

holes called the **Hounds**, wherein the Tyes do run to hoiſe

The Cap.

the yards, but the Top-Maſt hath but one hole or Hound, and one tye. Every Maſt alſo hath a **Cap** if a top; which is a piece of ſquare Timber with a round hole in it to receive,

Croſſe-trees.

the top Maſts or Flag-ſtaffe, to keep them ſteady and ſtrong, leaſt they be born by the board in a ſtiffe-gale. The **Croſſe-trees** are alſo at the head of the Maſts, one let into another

Treſſel-trees.

croſs, and ſtrongly boulted with the **Treſſel-trees** to keep up the top-Maſts which are faſtened in them, and thoſe are at the tops of each Maſts; all the Maſts ſtand upright but the Boultſpret which lyeth along over the Beak-head, and

Pillow.

that Timber it reſteth on is called the **Pillow**.

An example of the Yards by the Keel.

Now for the yards, ſuppoſe the Ship be 76 foot at the Keel, her main yard muſt be 21 yards in length, and in thickneſs but 17 inches. The fore-yard 19 yards long, and 15 inches diameter or thick. The ſpret-ſail yard 16 yards long, and but 9 inches thick, and your Miſen-yard ſo long as the Maſt, the Top-yards bears half proportion to the main, and Fore-yard, and the Top-gallants, the half to them,

them, but this rule is not absolute, for if your Masts be taunt, your Yards must be the shorter; if a low Mast, the longer: but this is supposed the best, to have the main Yard $\frac{5}{6}$ parts of her Keel in length: the top-Yard $\frac{4}{5}$ of the main-Yard; and the main-Yard for bigness $\frac{3}{4}$ parts of an inch, for a yard in length. The length of the fore-Yard $\frac{4}{5}$ of the main Yard: the crosjack-Yard and Spretsail Yard to be of a length, but you must allow the Missen-Yard and Spretsail Yard $\frac{1}{2}$ inch of thickness to a yard in length. But to give a true Arithmetical and Geometrical proportion for the building of all sorts of Ships, were they all built after one mould, as also of their Masts, Yards, Cables, Gordage, and Sails, were all the stuff of like goodness, a methodical rule as you see might be projected; but their lengths, breadths, depths, rakes and burthens are so variable and different, that nothing but experience can possibly teach it.

CHAP. IV.

The names of all the Masts, Tops, *and* Yards *belonging to a Ship.*

THe Boul-spret, the Spretsail-Yard, the Spretsail-Top-mast, the Spret-sail-Top sail-Yard, the fore-Mast, the fore-Yard, the fore-Top-mast, the fore-Top-sail-Yard, the fore-Top-gallant-Mast, the fore-Top gallant sail-Yard, Cotes, Wouldings, Gromits, and Staples for all Yards. The main-Mast, the main-Yard, the main-Top. The main-Top-Mast, the main Topsail-Yard. The Top-gallant Mast. The main-Top-gallant-sail-Yard. The *Truck* is a square piece of wood at the top, wherein you put the Flag-staff. The Misen, the Misen-Yard, the Misen Top-mast, the Misen-Top-sail Yard. The Cross Jack. In great Ships they have two Misens, the latter is called the Bonaventure-Misen.

A Jury Maſt, that is, when a Maſt is born by the board, with Yards, Roofs, Trees, or what they can, ſpliced or fiſhed together they make a Jury Maſt, woulding or binding them with Ropes faſt triced together with hand-ſpikes, as they uſe to would or bind any Maſt or Yard.

CHAP. V.

How all the Tackling *and* Rigging *of a Ship is made faſt one to another, with their names, and the reaſons of their uſe.*

Rigging or Cordage.
A Maſt well rigged.
A Yard well rigged.
Over-rigged.

THe **Rigging** a Ship, is all the Ropes or **Cordage** belonging to the Maſts and Yards; and it is proper to ſay, The Maſt is **well rigged**, or the Yard is **well rigged**, that is, when all the Ropes are well ſiſed to a true proportion of her burthen. We ſay alſo, when they are too many or too great, ſhe is **over-rigged**, and doth much wrong a Ship in her ſailing; for a ſmall weight aloft, is much more in that nature than a much greater below, and the more upright any Ship goeth, the better ſhe ſaileth.

All Maſts have Stays except one.
A Coller.
A Lannier.
Dead mens eyes.
Crowes-feet.

All the Maſts, Top-Maſts, and Flag-ſtaves have Stays, excepting the Spret-ſail Top-Maſt; the main-Maſt Stay is made faſt by a **Lannier** to a **Coller**, which is a great Rope that comes about the Head and Boult-ſpret, the other end to the head of the main-Maſt. The main Top-Maſt Stay is faſtned to the head of the Fore maſt by a ſtrop and a **dead mans eye**. The main Top-gallant-Maſts Stay in like manner to the head of the Fore-Top-Maſt. The fore Maſts and ſtays belonging to them in like manner are faſtned to the Boult-ſpret, and Spretſail Top-Maſt, and thoſe Stays do help to ſtay the Boultſpret. The Miſen ſtays do come to the main Maſt, and the Miſen Top-Maſt Stays to the Shrowds with **Crows feet**: The uſe of thoſe Stays are to keep the Maſts from falling aftwards, or too much forwards. Thoſe Lanniers are many ſmall Ropes reeved into the dead mens eyes of all Shrowds,

Shrowds, either to ſlacken them or ſet them taut; alſo all the Stays have their blocks, and Dead mens eyes have Lanniers. Dead mens eyes are blocks, ſome ſmall, ſome great, with many holes but no ſhivers; the Crows-feet reeved through them are a many of ſmall lines, ſometimes 6, 8, or 10, but of ſmall uſe more than for faſhion to make the Ship ſhew full of ſmall Ropes. **Blocks** or **Pullies** are thick pieces of wood having **ſhivers** in them, which is a little wheel fixed in the midſt with a **Cock** or **Pin**, ſome are braſs, but the moſt of wood, whereon all the **running Ropes** do run, ſome are little, ſome great, with 3, 4, or 5 ſhivers in them, and are called by the names of the Ropes whereto they ſerve. There are alſo **double Blocks**, that where there is uſe of much ſtrength will purchaſe with much eaſe, but not ſo faſt as the other, and when we hale any Tackle or Haleyard to which two blocks do belong, when they meet, we call that **block and block.**

Blocks or Pullies.
Shivers.
A Cock.
Running ropes
Double Blocks.
Block and Block.

The **Shrowds** are great Ropes which go up either ſides of all Maſts. The Miſen-main-Maſt and fore-Maſt Shrowds have at their lower ends Dead mens eyes ſeaſed into them, and are ſet up taut by Lanniers to the chains; at the other end, over the heads of thoſe Maſts are Pendants, for Tackles and Swifters under them. The Top-Maſt-Shrowds in like manner are faſtned with Lanniers and Dead-mens-eyes to the Puttocks or Plats of iron belonging to them, aloft over the head of the Maſt as the other: And the **Chains** are ſtrong Plates of iron faſt bolted into the Ships ſide by the Chain-waile. When the Shrowds are too ſtiff, we ſay, **eaſe them**, when too ſlack, we ſay, ſet **Taut the Shrouds**, but the Boultſpret hath no Shrowds, and all thoſe ſmall Ropes that croſs the Shrowds like ſteps are called **Ratlings**. The **Puttocks** go from the Shrowds of the fore-Maſt, main-Maſt or Miſen, to go off from the Shrowds into the Top, Cap, or Bowl, which is a round thing at the head of either Maſt for men to ſtand in, for when the Shrowds come near the top of the Maſt, they fall in ſo much, that without the Puttocks you could not get into the Top, and in a manner

All Maſts have Shrouds, &c.
Chains.
To eaſe.
Taught.
Ratlings.
Puttocks.

they are a kind of a Shrowd. A Pendant is a ſhort Rope made faſt at one end to the head of the Maſt or the Yards-arm, having at the other end a block with a ſhiver to reeve ſome running rope in, as the Pendants of the back-ſtays and Tackles hang a little down on the inſide of the Shrowds: all Yards-arms have them but the Miſen, into which the braces are reeved, and alſo there are Pendants or Streamers hang from the Yard-arms, made of Taffaty, or coloured Flanel-cloth to beautifie the Ship only: **Parrels** are little round Balls called Trucks, and little pieces of wood called **Ribs**, and ropes which do incircle the Maſts, and ſo made faſt to the Yards, that the Yards may ſlip up and down eaſily upon the Maſts, and with the help of the **Breſt-rope** doth keep the Yard cloſe to the Maſt. The **Standing-ropes** are the Shrowds and ſtays, becauſe they are not removed, except it be to be eaſed or ſet tauter.

Parrels.

Ribs.

Breſt-ropes.

Standing ropes.

The Tackles, are of divers ſorts, &c.

The **Tackles** or ropes run in three parts, having a Pendant with a block at the one end, and a block with a hook at the other, to heave any thing in or out of the Ship; they are of divers ſorts, as the **Bores-tackles** made faſt, the one to the fore Shrowds, the other to the main, to hoiſe the Boat in or out: Alſo the tackles that keep firm the Maſts from ſtraying. The **Gunners tackles** for haling in or out the Ordnance: but the **Winding tackle** is the greateſt, which is a great double block with three ſhivers to the end of a ſmall Cable about the head of the Maſt, and ſerveth as a Pendant; to which is made faſt a **Guy**, which is a rope brought to it from the fore Maſt, to keep the weight upon it ſteady, or from ſwinging to and again: Into the block is reeved a **Hawſer**, which is alſo reeved thorow another doublock, having a ſtrop at the end of it, which put thorow the eye of the ſlings is locked into it with a fid, and ſo hoiſe the goods in or out by the help of the **Snap block**.

Guy.

Hawſer.

Snap-block.

Cat-harpings.

Cat harpings are ſmall ropes run in little blocks from one ſide of the Ship to the other, neer the upper deck to keep the Shrowds tight for the more ſafety of the Maſts from rowling. The **Halyards** belong to all Maſts, for by them we hoiſe

Halyards.

hoiſe the Yards to their height, and the **Ties** are the ropes by which the Yards do hang, and do carry up the Yards when we ſtrain the Halyards; the main-Yard and fore-Yard Ties are firſt reeved thorow the Rams-head, then thorow the Hounds, with a turn in the eye of the ſlings which are made faſt to the Yard; the miſen-Yard and top-Yard have but ſingle Ties, that is, one doth but run in one part, but the Spret-ſail Yard hath none, for it is made faſt with a pair of ſlings to the boltſpret. A **Horſe** is a rope made faſt to the fore-maſt Shrowds, and the Spretſail ſheats, to keep thoſe ſheats cleur of the anchor-ſlookes.

The Ties.

A Horſe.

To **Sling** is to make faſt any Cask, Yard, Ordnance, or the like in a pair of **Slings**, and **Slings** are made of a rope ſpliced at either end into it ſelf with one eye at either end, ſo long as to be ſufficient to receive the Cask, the middle part of the rope alſo they ſeaſe together, and ſo maketh another eye to hitch the hook of the tackle, another ſort are made much longer for the hoiſting of Ordnance, another is a chain of iron to ſling or bind the Yards faſt aloft to the croſs trees in a fight, leſt the Tie ſhould be cut, and ſo the Maſt muſt fall. The **Canhookes** are two hooks faſtened to the end of a rope with a nooſe, like that the Brewers uſe to ſling or carry their barrels on, and thoſe ſerve alſo to take in or out Hogſheads, or any other commodities. A **Parbunkel** is two ropes that have at each end a nooſe or lump that being croſſed, you may ſet any veſſel that hath but one head upon them, bringing but the loopes over the upper end of the Cask, fix but the tackle to them, and then the Veſſel will ſtand ſtraight in the midſt to heave out, or take in without ſpilling.

To Sling.

Slings.

Canhookes.

A Parbunkel.

Puddings are ropes nailed round to the Yards arms cloſe to the end, a pretty diſtance one form another, to ſave the Robbins from galling upon the Yards, or to ſerve the anchors ring to ſave the clinch of the Cable from galling. And the **Robbins** are little lines reeved into the eylot holes of the Sail under the Head-ropes, to make faſt the Sail to the Yard, for in ſtead of tying, Sea-men always ſay, make faſt. **Head lines**, are the ropes that make all the Sails faſt to the Yard.

Puddings.

Robbins.

Head-lines.

Furling

Furling-lines. **Furling-lines** are ſmall lines made faſt to the Top-ſail, Top-gallant-ſail, and the Miſſen-yards arms. The Miſſen hath but one called the **Smiting line**, the other on each ſide one, and by theſe we farthel or bind up the Sails. The **Brales** are ſmall ropes reeved through blocks ſeaſed on each ſide the ties, and come down before the Sail, and at the very skirt are faſtened to the Creengles, with them we furle or farthel our Sails a croſs, and they belong only to the two Courſes and the Miſſen: to hale up the Brales, or brale up the Sail, is all one: **Creengles** are little ropes ſpliced into the Boltropes of all Sails belonging to the Main and Fore-maſt, to which the Bolings-bridles are made faſt, and to hold by when we ſhake off a Bonnet.

A ſmiting-line.

Brales.

Creengles.

Bolt-ropes. **Boltropes** is that rope is ſewed about every Sail, ſoft and gently twiſted, for the better ſewing and handling the Sails. **Bunt lines** is but a ſmall rope made faſt to the midſt of the Boltrope to a Creengle reeved through a ſmall Block which is ſeaſed to the Yard, to trice or draw up the bunt of the Sail, when you farthel or make it up. The **Clew-garnet** is a rope made faſt to the Clew of the Sail, and from thence runs in a block ſeaſed to the middle of the Yard, which in Furling doth hale up the Clew of the Sail cloſe to the middle of the Yard, and the **Clew-line** is the ſame to the Top-ſails, top-gallant, and Spret-ſails, as the Clew-garnet is to the Main and Fore-ſails. The **Clew** of a Sail is the lower corner next the Sheet and Tackes, and ſtretcheth ſomewhat goaring or ſloping from the ſquare of the Sail, and according to the **Goaring** ſhe is ſaid to ſpread a great or a little Clew. **Tackes** are great ropes which having a wall-knot at one end ſeaſed into the Clew of the Sail and ſo reeved firſt through the Cheſtres, and then cometh in at a hole in the Ships ſides, this doth carry forward the clew of the Sail to make it ſtand cloſe by a wind. The **Sheats** are bent to the Clews of all Sails, in the low-ſails they hale aft the Clew of the Sails, but in Top-ſails they ſerve to hale them home, that is, to bring the Clew cloſe to the Yards-arm. The **Braces** belong to all yards but the Miſſen, every yard

Bunt-lines.

Clew-Garnet.

Clew-line.

A Clew.

Goaring.

Tackes.

Sheats.

Braces.

hath

hath two reeved at their ends thorough two pendants, and thoſe are to ſquare the yards, or traverſe them as you pleaſe. The **Boling** is made faſt to the leech of the Sail about the midſt to make it ſtand the ſharper or cloſer by a winde, it is faſtened by two, three, or four Ropes like a Crows foot to as many parts of the Sail which is called the **Boling-bridles**, only the Miſſen-boling is faſtened to the lower end of the Yard, this Rope belongs to all Sails except the Spret-ſail, and Spret-ſail Top-ſail, which not having any place to hale it forward by, they cannot uſe thoſe Sails by a wind: **Sharp the main Boling**, is to hale it taut: **Hale up the Boling**, is to pull it harder forward on: **check** or **eaſe the Boling** is to let it be more ſlack.

Boling.

Boling-bridles.

Sharp the Boling.
Hale the Boling.
Check the Boling.

Lee-fannge is a Rope reeved into the Creengles of the courſes, when we would hale in the bottom of the Sail, to laſh on a bonnet, or take in the Sail; and **Reeving** is but drawing a Rope through a block or oylet to run up and down. **Leech-lines** are ſmall Ropes made faſt to the Leech of the top-ſails, for they belong to no other; and are reeved into a block at the Yard cloſe by the Top-ſail ties, to hale in the Leech of the Sail when you take them in. The **Leech of a Sail** is the outward ſide of a skirt of a Sail, from the earing to the clew; and the **Earing** is that part of the Bunt-rope which at all the four corners of the Sail is left open as it were a ring. The two upmoſt parts are put over the ends of the Yards-arms, and ſo made faſt to the Yards, and the lowermoſt are ſeaſed or bent to the Sheats, and tacks into the clew. The **Lifts** are two Ropes which belong to all Yards-arms, to top the Yards; that is, to make them hang higher or lower at your pleaſure. But the top-ſail **Lifts** do ſerve for Sheats to the Top-gallant-Yards, the haling them is called the topping the Lifts, as Top-a-ſtarboard, or Top-a-port.

Lee fannge.

Reeving.
Leech-lines.

Leech of a ſail.

Earings.

Bent.
Lifts.

Topping the Lifts.

Legs are ſmall Ropes put through the Bolt-ropes of the main and fore-ſail, near to a foot in length, ſpliced each end into the other in the Leech of the Sail, having a little eye whereunto the Martnets are faſtened by two hitches, and the end ſeaſed into the ſtanding parts of the **Martnets**, which

Legs.

Martnet.

are

are alſo ſmall lines like Crow-feet reeved through a block at the Top maſt-head, and ſo comes down by the Maſt to the Deck; but the Top-ſail Martnets are made faſt to the head of the Top-gallant maſt, and cometh but to the top, where it is haled and called the Top-martnets, they ſerve to bring that part of the Leech next the Yards-arm up cloſe to the Yard.

Latchets. **Latchets** are ſmall lines ſowed in the Bonnets and Drablers like loops to laſh or make faſt the Bonnet to the courſe, or the courſe to the Drabler, which we call **laſhing** the Bonnet to the courſe, or the Drabler to the Bonnet.

Laſhing.

The Loofe-hook. The **Loofe-hook** is a tackle with two hooks, one to hitch into a chingle of the main, or fore-Sail, in the Bolt-rope in the Leech of the Sail by the clew, and the other to ſtrap ſpliced to the **Cheſters** to

Cheſters. **houſe** or pull down the Sail to ſuccour the tacks in a ſtiff-gale of wind, or take off or put on a **Bonnet** or a **Drabler**, which are two ſhort ſails to take off or put to the fore-**Courſe** or the main, which is the fore Sail, or main-Sail.

Houſe.

A Bonner.
A Drabler.
A Courſe.

A Knave-line. The **Knave-line** is a Rope hath one end faſtened to the croſs-trees, and ſo comes down by the ties to the Rams-head, to which is ſeaſed a ſmall piece of wood ſome two foot long with a hole in the end, whereunto the line is reeved, and brought to the Ships ſide, and haled taut to the Railes to keep the ties and Halyards from turning about one another when they are new.

Knettels. **Knettels** are two Rope-yarnes twiſted together, and a knot at each end, whereunto to ſeaſe a block, a rope, or the like.

Rope-yarnes. **Rope-yarns** are the Yarnes of any rope untwiſted, they ſerve to ſarve ſmall ropes, or make **Sinnet, Mats, Plats**, or **Caburns**, and make up the Sails at the Yards-arms.

Sinnet. **Sinnet** is a ſtring made of Rope-yarn commonly of two, four, ſix, eight or nine ſtrings platted in three parts, which being beat flat they uſe it to ſarve ropes or **Mats**.

Mats or Panch. That which we call a **Panch**, are broad clouts, woven of Thrums and Sinnet together, to ſave things from galling about the main and fore-Yards at the Ties, and alſo from the Maſts, and upon the Boltſpret, Loufe, Beake head or Gunwaile, to ſave the clewes of the Sails from galling or fretting.

Caburn

Caburne is a ſmall line made of Spun-yarn to make a bend of two Cables, or to ſeaſe the Tackels, or the like. Caburne.

Seaſing is to bind faſt any ropes together, with ſome ſmall rope-yarne. Seaſing.

Marline is any line, to a block, or any Tackle, Pendant, Garnet, or the like. There is alſo a rope by which the Boat doth ride by the Ships ſide, which we call a **Seaſen.** Seaſen.

To **ſarve** any rope with Plats or Sinnet, is but to lay Sinnet, Spun-yarn, Rope-yarn, or a piece of Canvas upon the rope, and then rowl it faſt to keep the rope from galling about the Shrowds at the head of the Maſts, the Cable in the Hawſe, the flook of the Anchor, the Boat-rope or any thing. Sarve or Sirvis.

Spunyarn is nothing but rope-yarn made ſmall at the ends, and ſo ſpun one to another ſo long as you will with a winch. Spunyarn.

Alſo **Caskets** are but ſmall ropes of Sinnet made faſt to the gromits or rings upon the Yards, the longeſt are in the midſt of the Yards betwixt the Ties, and are called the breſt-Caskets, hanging on each ſide the Yard in ſmall lengths only to bind up the Sail when it is furled. Caskets.

Marling is a ſmall line of untwiſted hemp, very pliant and well tarred, to ſeaſe the ends of Ropes from raveling out, or the ſides of the blocks at their arſes, or if the Sail rent out of the Boltrope, they will make it faſt with Marlin till they have leiſure to mend it. Marling.

The **Marling ſpike**, is but a ſmall piece of Iron to ſplice ropes together, or open the Boltrope when you ſew the ſail. Marling-ſpike.

Splicing is ſo to let one ropes end into another, they ſhall be as firm as if they were but one rope, and this is called a **round Splice**; but the **cut Splice** is to let one into another with as much diſtance as you will, and yet be ſtrong, and undo when you will. Splicing. A round ſplice. A cut Splice.

Now to make an end of this diſcourſe with a **knot**, you are to know, Seamen uſe three, the firſt is called the **Wall-knot**, which is a round knob, ſo made with the ſtrouds or layes of a rope, it cannot ſlip; the Sheets, Tackes, and Stoppers uſe this knot. A Knot. A Wall-Knot.

The **Boling knot** is alſo ſo firmly made and faſtened by the bridles into the creengles of the Sails, they will break, or the Sail ſplit before it will ſlip. A Boling-knot.

The laſt is the **Sheepſhank** which is a knot they caſt them upon a runner or Tackle when Sheepſhanks-Knot.

it is too long to take in the goods, and by this knot they can ſhorten a Rope without cutting it, as much as they liſt, and preſently undo it again, and yet never the worſe.

CHAP. VI.

What doth belong to the Boats *and* Skiffe, *with the definition of all thoſe Thirteen* Ropes *which are only properly called* Ropes *belonging to a Ship and the* Boat, *and their uſe.*

A Long-Boat.

OF Boats there are divers ſorts, but thoſe belonging to Ships, are called either the **Long Boat**, or Ships Boat, which ſhould be able to weigh her Sheet-Anchor, thoſe will live in any reaſonable Sea, eſpecially the Long-Boat: Great Ships have alſo other ſmall Boats called **Shallops** and **Skiffs**, which are with more eaſe and leſs trouble rowed to and again upon any ſmall occaſion. To a Boat belongs a Maſt and Sail, a Stay-ſheet and Halyard, Rudder, and Rudder-Irons, as to a Ship, alſo in any Diſcovery they uſe a **Tarpawling**, which is a good piece of Canvas waſhed over with Tar, to cover the **Bailes** or Hoopes over the Stern of their Boat, where they lodg in an Harbour, which is that you call a Tilt covered with Wadmall in your Wherries; or elſe an **Awning**, which is but the Boats-ſail, or ſome piece of an old Sail brought over the Yard and Stay, and boomed out with the Boat-hook, ſo ſpread over their heads, which is alſo much uſed, as well a ſhore as in a Ship, eſpecially in hot Countries to keep men from the extremity of heat or wet, which is very oft infectious. **Thoughts** are the Seats whereon the Rowers ſit; and **Thowles** ſmall Pines put into little holes in the Gunwails or upon the Boats-ſide, againſt which they bear the Oars when they row, they have alſo a David; and alſo in Long-

A Shallop. A Skiff.

Tarpawling. Bailes.

Awning.

Thoughts. Thowles.

Boats

boats a windleſs to weigh the Anchor by, which is with more eaſe than the Ship can. The two arching-timbers againſt the boat-head are called Carlings. Man the boat is to put a **Gang** of men, which is a company into her, they are commonly called the Coxſwains Gang, who hath the charge of her. **Free the Boat** is to bail or caſt out the water. **Trim the Boat** is to keep her ſtraight. **Wind the Boat** is to bring her head the other way. **Hold water** is to ſtay her. **Forbear** is to hold ſtill any Oar you are commanded, either on the broad, or whole ſide. A freſh **Spell** is to relieve the Rowers with another Gang. Give the Boat more way for a dram of the Bottel, who ſays Amends, one and all, **Vea, vea, vea vea, vea**, that is, they pull all ſtrongly together.

A Gang.

Free or Bail.
Trim Boat.
Wind Boat.
Hold water.
Forbear.
A Spell.

Vea, vea, vea.

The **Entering rope** is tyed by the Ships ſide, to hold by as you go up the entering Ladder, cleats, or wailes.

The Entering-rope.

The **Bucket-rope** that is tied to the Bucket by which you hale and draw water up by the Ships ſide.

Bucket-rope.

The **Bolt-ropes** are thoſe wherein the Sails are ſowed.

Bolt-ropes.

The **Port-ropes** hale up the Ports of the Ordnance.

Port-ropes.

The **Jeare-rope** is a piece of a Hawſer made faſt to the Main-yard, another to the Fore-yard cloſe to the Ties, reeved through a Block which is ſeaſed cloſe to the top, and ſo comes down by the Maſt, and is reeved through another Block at the bottom of the Maſt cloſe by the Deck; great Ships have on each ſide the Ties one, but ſmall Ships none: the uſe is to help to hoiſe up the Yard to ſuccour the Ties, which though they break yet they would hold up the Maſt.

Jeare-rope.

The **Preventer-rope** is a little one ſeaſed croſs over the Ties, that if one part of them ſhould break, yet the other ſhould not run through the Rams-head to indanger the Yard.

Preventer-rope.

The **Top-ropes** are thoſe wherewith we ſet or ſtrike the main or fore top-maſts, it is reeved through a great Block ſeaſed under the Cap, reeved through the heel of the Top-maſt thwart Ships, and then made faſt to a ring with a clinch on the other ſide the Cap, the other part comes down

Top-rope.

by the Ties, reeved into the Knights, and ſo brought to the Capſtain when they ſet the Top-maſts.

Keel-ropes. The **Keel rope**, you have read in the building, is of hair in the Keel to ſcower the Limber-holes.

Rudder-rope. The **Rudder-rope** is reeved through the Stem-poſt, and goeth through the head of the Rudder, and then both ends Spliced together, ſerves to ſave the Rudder if it ſhould be ſtruck off the Irons.

Cat-rope. The **Cat-rope** is to hale up the Cat.

Boy-rope. The **Boy rope** is that which is tied to the Boy by the one end, and the Anchors flook by the other.

Boat-rope. The **Boat-rope** is that which the Ship doth tow her Boat by, at her Stern.

Cheſt-rope. The **Cheſt rope** is added to the Boat-rope when ſhe is towed at the Ships ſtern, to keep her from **ſhearing**, that is, from ſwinging to and again; for in a ſtiff gale ſhe will make ſuch yaws, and have ſuch girds, it would indanger her to be torn in pieces, but that they uſe to **ſwift** her, that is, to incircle the Gunwaile with a good rope, and to that make faſt the **Cheſt-rope**.

Shearing.

Swifting.

CHAP.

CHAP. VII.

The Names of all sorts of Anchors, Cables, *and* Sails; *and how they bear their proportions, with their use: Also how the* Ordnance *should be placed, and the* Goods *stowed in a Ship.*

THE proper terms belonging to **Anchors** are many: the least are called **Kedgers**, to use in calm weather in a slow stream, or to kedge up and down a narrow River, which is when they fear the wind or tide may drive them on shore; they row by her with an Anchor in a Boat, and in the midst of the stream, or where they find most fit if the Ship come too near the shore, and so by a Hawser wind her head about, then weigh it again till the like occasion, and this is **Kedging**. There is also a **Stream-Anchor** not much bigger, to stem an easie stream or tide. Then there is the **first, second,** and **third Anchor**, yet all such as a Ship in fair weather may ride by, and are called Bow-Anchors. The greatest is the **Sheet-Anchor**, and never used but in great necessity. They are commonly made according to the Burthen of the Ship by proportion, for that the Sheet-Anchor of a small Ship will not serve for a Kedger to a great Ship. Also it beareth a proportion in it self, as the one flook, which is that doth stick in the ground, is but the third part of the **Shank** in length; at the head of the shank there is a hole called an **Eye**, and in it a **Ring**, wherein is the **Nut** to which there is fast fixed a **Stock** of wood crossing the **Flooks**, and the length is taken from the length of the Shank. These differ not in shape but in weight, from two hundred, to three or four thousand weight. **Grapels** or **Graplings**, are the least of all, and have four Flooks but

A Kedger.

Stream-Anchor.

The first, Second, Third Anchor.

Sheet-Anchor.

An Anchors Shank. Flook. Shoulder. Beam or Nut. Eye. Ring. Stock.

Grappels.

but no ſtock; for a Boat to ride by, or to throw into a Ship in a fight, to pull down the gratings or hold faſt.

A Cable, the firſt, ſecond, and third.

The **Cables** alſo carry a proportion to the Anchors, but if it be not three ſtroud, it is accounted but a Hawſer, yet a great Ships Hawſer may be a Cable to the Sheet-anchor for a ſmall Ship: and there is the firſt, ſecond, and third Cable,

Sheet-Anchor-Cable.

beſides the **Sheet-Anchor Cable.** If the Cable be well

Keckell.

made, we ſay it is well laid. To **Keckell** or ſarve the Cable, as is ſaid, is but to bind ſome old clouts to keep it from gal-

Splice.

ling in the Hawſe or Ring. **Splice** a Cable, is to faſten two ends together, that it may be double in length, to make

A ſhot of Cable.

the Ship ride with more eaſe, and is called a **ſhot of Cable.**

Quoile.
A Fake.

Quoile a Cable, is to lay it up in a round Ring, or **fake** one above another.

Pay more Cable.

Pay more Cable, is when you carry an Anchor out in the Boat to turn over.

Pay-cheape.

Pay cheap, is when you over ſet it, or turns it over-board faſter.

Veere mora Cable.

Veere more Cable, is when you ride at Anchor. And

End for end.

end for end is when the Cable runneth clear out of the Hawſe, or any rope out of his ſhiver. A

A Bight.

Bight is to hold by any part of a coile, that is, the upmoſt fake. A

A Bitter.

Bitter is but the turn of a Cable about the Bits, and veere it out by little and little. And the

A Bitters end.

Bitters end is that part of the Cable doth ſtay within

Gert.

board. **Gert,** is when the Cable is ſo taut that upon the turning of a tide, a Ship cannot go over it.

To bend
Unbend.

To **bend the Cable** to the Anchor, is to make it faſt to the Ring; **unbend the Cable,** is but to take it away, which we uſually do when we are at Sea, and to tie two ropes or

Bending.
Hitch.

Cables together is called **bending.** **Hitch,** is to catch hold of any thing with a rope to hold it faſt, or with a hook, as hitch the Fiſh-hook to the Anchors flook, or the Tackles into the Garnets of the Slings. **Fenders** are pieces of old

Fenders.
Junkes.

Hauſers called **Junkes** hung over the Ship-ſides to keep them from bruiſing. In Boats they uſe Poles or Boat-

Breſt-faſt.

hooks to fend off the Boat from bruiſing. A **Breſt faſt** is a rope which is faſtened to ſome part of the Ship forward on,

Stern-faſt.

to hold her head to a Wharff or any thing, and a **Stern faſt** is the ſame in the Stern. The uſe for the Hawſer is to

warp

warp the Ship by, which is laying out an Anchor, and wind her up to it by a Capſtern. **Houſing** is but pulling the ſlackneſs of any Cables with mens hands into the Ship. The **Shank-panter** is a ſhort chain faſtened under the Foremaſts ſhrowds with a bolt to the Ships ſides, and at the other end a rope to make faſt the Anchor to the Bowe. To **Stop** is when you come to an Anchor, and veeres out your Cable, but by degrees till the Ship ride well, then they ſay ſtop the Ship. To thoſe Cables and Anchors belong ſhort pieces of wood called **Boys**, or cloſe hooped Barrels like Tankards as is ſaid, but much ſhorter, to ſhew you the Anchor and help to weigh it, there is another ſort of Cans called **Can Boys** much greater, moored upon ſhoules to give Marriners warning of the dangers.

Rouſing.
Shank-panter.
Stop.
Boyes.
Can-Boyes.

The **Main ſail** and the **Foze ſail** is called the **Foze-courſe**, and the **main courſe**, or a pair of Courſes. **Bonits** and **Drablers** are commonly one third part a piece to the Sail they belong unto in depth, but their proportion is uncertain; for ſome will make the main-Sail ſo deep, that with a ſhallow **Bonit** they will cloath all the Maſt without a **Drabler**, but without Bonnets we call them but Courſes; we ſay, laſh on the Bonet to the Courſe, becauſe it is made faſt with Latchets into the Eylot-holes of the Sail, as the Drabler is to it, and uſed as the wind permits. There is alſo your **Main-top ſail**, and **Foze-top-ſail**, with their **Top-gallant-ſails**, and in a fair Gale your **Studding-ſails**, which are Bolts of Canvaſs, or any cloth that will hold wind, we extend alongſt the ſide of the Main ſail, and Booms it out with a Boom or long Pole, which we uſe alſo ſometimes to the Clow of the Main-ſail, Fore-ſail, and Spret ſail, when you go before the Wind or Quartering, elſe not. Your **Miſen**, and **Miſen-top-ſail**, your Spret and **Spret-top-ſail**, as the reſt, take all their names of their Yards. A **Drift-ſail** is only uſed under water, veered out right a head by Sheets, to keep the Ships-head right upon the Sea in a ſtorm, or when a Ship drives too faſt in a current. A **Netting ſail** is only a Sail laid over the **Netting**, which is ſmall Ropes from the top of the

Sailes.
Main-Sail.
Fore-Sail.
Main-courſe.
Fore-courſe.
Bonnets.
Drablers.
Main-top-ſail.
Fore-top-ſail.
Top-gallant-Sails.
Studding-ſails.
Miſen.
Miſen-top-ſail.
Spret-ſail.
Spret-ſail-top.
Sail.
Driſt-ſail.
Netting-ſail.
Nettings.

the Fore caſtle to the Poop, ſtretched upon the Ledges from the **Waiſt-trees** to the **Rouſe trees**, which are only ſmall Timbers to bear up the **Gratings** from the half-Deck to the Fore-caſtle, ſupported by **Stantions** that reſt upon the half-Deck; and this Netting or **Grating**, which is but the like made of Wood, you may ſet up or take down when you pleaſe, and is called the cloſe Fights fore and aft. Now the uſe of thoſe Sails is thus, all **Head-ſails**, which are thoſe belonging to the Fore maſt and Bolt ſpret, do keep the Ship from the Wind or to fall off: All **After-ſails**, that is, all the Sails belonging to the Main-maſt and Miſen, keeps her to Wind-ward, therefore few Ships will ſtear upon Quarter-winds with one Sail, but muſt have one after Sail, and one Head-ſail. The Sails are cut in proportion as the Maſts and Yards are in breadth and length, but the Spret-ſail is $\frac{3}{4}$ parts the depth of the Fore ſail, and the Miſen by the Leech twice ſo deep as the Maſt is long from the Deck to the Hounds. The **Leech** of a Sail is the outward ſide or skirt of the Sail from the Earing to the Clew, the middle betwixt which we account the Leech. The **Clew**, is the lower corner of a Sail, to which you make faſt your Sheets and Tacks, or that which comes goring out from the ſquare of the Sail, for a Square-ſail hath no Clew, but the Main ſail muſt be cut **Goring**, becauſe the Tacks will come cloſer aboard, and ſo cauſe the Sail to hold more wind; now when the Sail is large and hath a good Clew, we ſay ſhe ſpreads a large Clew, or ſpreads much Canvas. In making thoſe Sails they uſe two ſorts of Seams down the Sails, which doth ſew the breadth of the Canvas together, the one we call a **Monk ſeam**, which is flat, the other a **Round ſeam**, which is ſo called becauſe it is round.

Waiſt-trees.
Rouſe-trees.
Stantions.
Gratings.
Head-Sails.
After-Sails.
Leech.
The Clew.
Goring.
A Monk-ſeam.
A Round-ſeam.

The Ship being thus provided, there wants yet her *Ordnance*, which ſhould be in greatneſs according to her building in ſtrength and burthen, but the greateſt commonly lieth loweſt, which we call the lower **Tier**, if ſhe be furniſhed fore and aft. Likewiſe the ſecond Tier, and the third, which are the ſmalleſt. The Fore-caſtle and the half-

A Tier.
Third.
Second.

half Deck being alſo furniſhed, we account half a Tier. Half a Tier.

Stowage or to Stow, is to put the goods in Howl in order. The moſt ponderous next the Ballaſt, which is next the Keelſon to keep her ſtiffe in the Sea. **Ballaſt** is either Gravel, Stones, or Lead, but that which is drieſt, heavieſt, and lies cloſeſt is beſt. To find a leak, they **Trench the Ballaſt**, that is, to divide it. The Ballaſt will ſometimes **Shoot**, that is, run from one ſide to another, and ſo will Corn and Salt, if you make not Pouches or Bulk-heads, which when the Ship doth heeld is very dangerous to overſet or turn the Keel upwards. For Cask that is ſo ſtowed, Tier above Tier with Ballaſt, and **Canting-Coines**, which are little ſhort peices of wood or Billets cut with a ſharp ridge or edge to lie betwixt the Cask; and **Standing-Coines** are Billets or Pipe-ſtaves, to make them they cannot give way nor ſtir. The Ship will **bear much**, that is, carry much Ordnance or goods, or bear much Sail; and when you let any thing down into the Howl, lowering it by degrees, they ſay, **Amain**; and being down, **Strike**.

Stowage. To Stow. Ballaſt. Trench the Ballaſt. Shoot. Canting-Coins. Standing-Coins. To bear. Amain. Strike.

CHAP. VIII.

The Charge *and* Duty *of the* Captain *of a Ship, and every* Office *and* Officer *in a* Man of War.

The Captains Charge.

THE **Captains** Charge is to command all, and tell the Master to what Port he will go, or to what Height. In a Fight, he is to give Direction for the managing thereof, and the Master is to see the cunning of the Ship, and Trimming of the Sails.

The Master and his Mates.

The **Master** and his **Mates** are to direct the course, command all the Sailers, for Steering, Trimming, and Sailing the Ship; his Mates are only hid Seconds, allowed sometimes for the two Mid-Ships Men, that ought to take charge of the first prize.

The Pilot.

The **Pilot** when they make Land doth take the charge of the Ship till he bring her to Harbour.

The Chirurgion and his Mate.

The **Chirurgion** is to be exempted from all duty, but to attend the Sick, and cure the wounded: and good care would be had he have a Certificate from Barber-Chirurgions Hall of his sufficiency, and also that his Cheft be well furnished both for Physick and Chirurgery, and so near as may be, proper for that clime you go for, which neglect hath been the loss of many a mans Life.

The Cap-Merchant or Purser.

The **Cap Merchant** or **Purser** hath the charge of all the Carragasoun or Merchandize, and doth keep an account of all that is received, or delivered, but a Man of War hath only a Purser.

The Gunner with his Mate, and quarter Gunners.

The Master **Gunner** hath the Charge of the *Ordnance*, and *Shot*, *Powder*, *Match*, *Ladles*, *Sprunges*, *Worms*, *Cartrages*, *Arms* and *Fire-Works*; and the rest of the **Gunners**, or **Quarter Gunners** to receive their Charge from him according to directions, and to give an account of their stores.

The Carpenter and his Mate.

The **Carpenter** and his **Mate**, is to have the *Nails*, *Clinches*, *Roove* and *Clinch-nailes*, *Pikes*, *Splates*, *Rudder Irons*, *Pump-*

Pump nails, *Skupper nails*, and *Leather*, *Sawes*, *files*, *Hatchets*, and ſuch like, and ever ready for calking, Breaming, Stopping leaks, Fiſhing, or ſplicing the Maſts or Yards as occaſion requireth, and to give account of his Store.

The **Boatſwain** is to have the Charge of all the *Cordage*, *Tackling*, *Sails*, *Fids* and *Marling-ſpikes*, *Needles*, *Twine*, *Sail-cloth*, and *Rigging* the Ship, his **Mate** the Command of the *Long Boat*, for the ſetting forth of *Anchors*, weighing or fetching home an *Anchor*, *Warping*, *Towing*, or *Moring*, and to give an account of his Store. The Boatſwain and his Mate.

The **Trumpeter** is always to attend the Captains Command, and to ſound either at his going a Shore, or coming aboard, at the entertainment of Strangers, alſo when you hale a Ship, when you charge, board, or enter; and the Poop is his place to ſtand or ſit upon, if there be a noiſe, they are to attend him, if there be not, every one he doth teach to bear a part, the Captain is to incourage him, by increaſing his Shares, or pay, and give the Maſter Trumpeter a reward. The Trumpeter.

The **Marſhal** is to puniſh Offenders, and to ſee Juſtice executed according to Directions; *As Ducking at the Yards Arm*, *haling under the Keel*, *bound to the Capſtern*, *or main-Maſt with a Basket of Shot about his Neck*, *ſetting in the Bilbowes*, and to pay the *Cobty* or the *Morjoune*; but the Boys the Boatſwain is to ſee every Munday at the Cheſt, to ſay their compaſs, and receive their puniſhment for all their Weeks offences, which done, they are to have a quarter Can of Beer, and a Biſket of Bread, but if the Boatſwain Eat or Drink before he catch them, they are free. The Marſhal.

The **Corporal** is to ſee the *Setting* and *Releiving the Watch*, and ſee all the Souldiers and Sailers keep their arms clean, Neat, and Yare, and teach them their uſe. The Corporal.

The **Steward** is to deliver out the *Victuals* according to the Captains directions, and Meſs them four, five, or ſix, as there is occaſion. The Steward. and his Mate.

The **Quarter-Maſters** have the Charge of the *Howle*, for *Stowing*, *Romaging* and *Trimming* the Ship in the hold, and The Quarter-Maſter.

and of their *Squadrons* for the *Watch*, and for *Fiſhing* to have a *Sayne*, a *Fiſgig*, a *Harpin-yron*, and *Fiſhhooks*, for *Porgos*, *Bonetos*, *Dolphins*, or *Dorados*, and *Rayling-lines* for *Mackrels*.

The Cooper and his Mate.

The **Cooper** is to look to the *Cask*, *Hoops* and *Twigs*, *to ſtave* or *repair* the *Buckets*, *Baricos*, *Cans*, *Steep-tubs*, *Runlets*, *Hogſheads*, *Pipes*, *Buts*, *&c.* For *Wine*, *Bear*, *Sider*, *Beverage*, *Freſh-water*, or any Liquor.

The Coxſwain and his Mate.

The **Coxſwain** is to have a choice *Gang* to attend the Skiffe, to go to and again as occaſion commandeth.

The Cook and his Mate.

The **Cook** is to dreſs and deliver out the Victual, he hath his Store of *Quarter Cans*, *ſmall Cans*, *Platters*, *Spoons*, *Lanthornes*, &c. And is to give his Account of the remainder.

The Swabber.

The **Swabber** is to waſh and keep clean the Ship and Maps.

The Lyar.

The **Liar** is to hold his place but for a week, and he that is firſt taken with a lie, every Monday is ſo proclaimed at the main-Maſt by a general cry, *a Liar*, *a Liar*, *a Liar*, he is under the Swabber, and only to keep clean the Beakhead, and Chains.

The Sailers.

The **Sailers** are the ancient men for hoiſing the Sails, getting the tacks aboard, haling the Bowling, and Steering the Ship.

The Younkers

The **Younkers** are the young men called *fore-Maſt-men* to take in the top ſails, or Top and Yard, for furling the Sails, or Slinging the Yards, Bouſing or Triſing, and take their turns at Helm.

The Lieutenant, his place.

The **Lieutenant** is to aſſociate the *Captain*, and in his abſence to execute his place, he is to ſee the *Marſhal* and *Corporal* do their duties, and aſſiſt them in inſtructing the Souldiers, and in a fight the fore-caſtle is his place to make good, as the *Captain* doth the *Half-deck*, and the *Quarter-Maſters*, or *Maſters-Mate*, the *Mid-ſhips*, and in a *Statesman of War*, he is allowed as neceſſary as a *Lieutenant* on Shore.

CHAP. IX.

Proper Sea-terms for dividing the Company at Sea, and ſteering, ſailing, or moving a Ship in fair weather, or in a ſtorm.

IT is to be ſuppoſed by this the Ship is victualled and manned, the Voyage determined, the **ſteep-Tubs** in the Chains to ſhift their Beef, Pork, or Fiſh in ſalt water, till the ſalt be out, though not the ſaltneſs, and all things elſe ready to ſet ſail; but before we go any further, for the better underſtanding the reſt, a few words for **ſteering** and **cunning** the Ship would not be amiſs. Then know, **Starboard** is the right hand, **Larboard** the left; Starboard the Helm, is to put the Helm a Starboard, then the Ship will go to the Larboard. **Right your Helm**, that is, to keep it in the mid Ships, or right up. **Port**, that is, to put the Helm to Larboard, and the Ship will go to the Starboard, for the Ship will ever go contrary to the Helm. Now by a quarter wind, they will ſay **aloof**, or **keep your Loof**, keep her to it, have a care of your Lee-latch. Touch the wind, and **war no more**, is no more but to bid him at the Helm to keep her ſo near the wind as may be; **no near**, **eaſe** the Helm, or bear up, is to let her fall to Lee ward. **Steady**, that is, to keep her right upon that point you ſteer by; be **pare** at the Helm, or a freſh man to the Helm. But he that keeps the Ship moſt from yawing, doth commonly uſe the leaſt motion with the Helm, and thoſe ſteer the beſt.

Steep-Tubs.
Stearing.
Cunning.
Starboard.
Larboard.
Mid ſhips.
Port.
Aloof.
Keep your loof.
War no more.
No near.
Eaſe.
Steady.
Yare.

The Maſter and Company being aboard, he commands them to get the Sails to the Yards, and about your **gear**, or work on all hands, ſtretch forward your main Hallyards, hoiſe your Sails half Maſt high. **Prey**, or make ready to ſet ſail, croſs your Yards, bring your Cable to the Capſtern; Boatſwain fetch an Anchor aboard, break ground or weigh Anchor. Heave a head, men into the Tops, men upon the Yards; come, is the Anchor, **a pike**, that is, to heave the Hawſe

Gear.
Prey.
A Pike.

Hawſe of the ſhip right over the Anchor: what is the Anchor away? Yea, yea. Let fall your Fore-ſail. **Tally**, that is, hale off the Sheats; who is at the Helm there? coil your Cables in ſmall fakes, hale the Cat, a Bitter, belay, looſe faſt your Anchor with your Shank-painter, ſtow the Boat, ſet the land, how it bears by the Compaſs, that we may the better know thereby to keep our account, and direct our courſe, let fall your Main ſail, every man ſay his private Prayer for a boon Voyage, out with your ſpret-ſail, on with your Bonnits and Drablers, ſteer ſteady and keep your courſe, ſo, you go well.

Tally.

How they divide the Company at Sea, and ſet, and rule the Watch.

WHen this is done, the Captain or Maſter commands the Boatſwain to call up the Company; the Maſter being chief of the Starboord-watch, doth call one, and his right hand Mate on the Larboard doth call another, and ſo forward till they be divided into two parts, then each man is to chuſe his Mate, Conſort, or Comrade, and then divide them into ſquadrons according to your number and burthen of your Ship, as you ſee occaſion; theſe are to take their turns at the Helm, trim ſails, pump, and do all duties each half, or each ſquadron for eight Glaſſes, or four hours, which is a Watch; but care would be had, that there be not two Comrades upon one Watch, becauſe they may have the more room in their Cabbins to reſt. And as the Captain and Maſter's Mates, Gunners, Carpenters, Quartermaſters, Trumpeters, *&c.* are to be abaft the Maſt, ſo the Boatſwain, and all the Yonkers or common Sailers under his command is to be before the Maſt. The next is, to meſs them four to a Meſs, and then give every Meſs a quarter Can of Beer, and a Biſket of Bread to ſtay their ſtomacks till the Kettle be boiled, that they may firſt go to Prayer, then to ſupper, and at ſix a Clock ſing a Pſalm, ſay a Prayer, and the Maſter with his ſide begins the Watch, then all the reſt may do what

what they will till midnight; and then his Mate with his Larboard men, with a Pſalm and a Prayer, relieves them till four in the Morning, and ſo from eight to twelve each other, except ſome flaw of wind come, ſome ſtorm, or guſt, or ſome accident that requires the help of all hands which commonly after ſuch good Cheer in moſt Voyages doth happen.

For now the **wind veers**, that is, it doth ſhift from point to point, get your Starboard-tackes aboard, and **tally** or hale off your Lee ſheets. The Ship will not wayer, ſettle your main Top-ſail, veere a fadome of your ſheet. The wind comes fair again and a freſh gale, hale up the Slatch of the Lee-boling. By Slatch is meant the middle part of any Rope hangs over-board. Veere more ſheet, or a **flown** ſheet, that is, when they are not haled home to the Block. But when we ſay, let **fly** the ſheets, then they let go amain, which commonly is in ſome guſt, leſt they ſpend their Top-ſails, or if her quick ſide lie in the water, over-ſet the Ship. A Flown-ſheet is when ſhe goes before the wind, or betwixt a **pair of ſheets**, or all Sails drawing. But the wind ſhrinks, that is, when you muſt take in the Spret-ſail, and get the Tacks aboard, hale cloſe the main Boling, that is, when your Tacks are cloſe aboard. If you would ſail againſt the wind, or keep your own, that is, not to fall to Lee-ward, or go back again, by haling off cloſe your Bolings, you ſet your Sails ſo ſharp as you can to lie cloſe by a wind, thwarting it a League or two, or more or leſs, as you ſee cauſe, firſt on the one board, then on the other; this we call boarding or beating it up upon a Tack in the winds eye, or bolting to and again; but the longer your Boards are, the more you work or gather into the wind. If a ſudden flaw of wind ſhould ſurprize you, when you would lower a Yard ſo faſt as you can, they call *Amain*; but a croſs ſail cannot come nearer the wind than ſix points, but a Carvel, whoſe Sails ſtands like a pair of Tailers ſheers, will go much nearer.

The wind veers.
Tally.
Flown.
Fly.
A pair of courſes.

How

How to handle a Ship in a Storm.

IT overcasts, we shall have wind, foul weather, settle your Top-sails, take in the Spret-sail, in with your Top-sails, lower the Fore-sail, tallow under the Parrels, brade up close all them Sails, lash sure the Ordnance, strike your Top-masts to the Cap, make it sure with your Sheeps-feet.

Try. A storm, let us lie at **Trie** with our main-Course, that is, to hale the Tack aboard, the Sheet close aft, the Boling set up, and the Helm tied close aboard. When that will not serve, then try the Misen, if that split, or the storm grow so

Hull. great that she cannot bear it, then **hull**, which is to bear no sail, but to strike a hull is when they would lie obscurely in the Sea, or stay for some Consort, lash sure the Helm a lee,

Under the Sea. and so a good Ship will lie at ease **under the Sea**, as we

Weather coil. term it. If she will **weather coil**, and lay her head the other way without loosing a sail, that must be done by bearing up the Helm, and then she will drive nothing so far to Lee-ward. They call it hulling also in a calm swelling Sea, which is commonly before a storm, when they strike their Sails lest

Rowling. she should beat them in pieces against the Mast by **Rowling**.

Labour. We say a Ship doth **Labour** much when she doth rowl much any way; but if she will neither Trie nor Hull,

Spoon: then **spoon**, that is, put her right before the wind, this way although she will rowl more than the other, yet if she be

Trough. weak, it will not strain her any thing so much in the **Trough** of the Sea, which is the distance betwixt two Waves or Billows. If none of this will do well, then she is in danger to

Founder. **founder**, if not sink. **Foundering** is, she will neither veer nor steer, the Sea will so over-rake her, except you free out the water, she will lie like a Log, and so consequently

To spend a Mast. sink. **To spend a Mast** or **Yard** is when they are broke

Spring a Mast. by foul weather, and to **spring a Mast** is when it is cracked in any place.

In this extremity he that doth cun the Ship, cannot have too much judgment, nor experience to **try her drift**, or how she

ſhe **Caps**, which are two terms alſo uſed in the Trials of the running or ſetting of currants. A **poke** is when the Sea is ſo rough as that men cannot govern the Helm with their hands, and then they ſeaſe a block to the Helm on each ſide the end, and reeving two fals thorow them like Gunners Tackles, brings them to the Ship ſide, and ſo ſome being at the one ſide of the Tackle, ſome at the other, they ſteer her with much more eaſe then they can with a ſingle rope with a double turn about the Helm. A Yoke

When the Storm is paſt, though the wind may alter three or four points of the Compaſs, or more, yet the Sea for a good time will go the ſame way; then if your courle be right againſt it, you ſhall meet it right a head, ſo we call it **a Head Sea**. Somtimes when there is but little wind, there will come a contrary Sea, and preſently the wind after it, whereby we may Judg that from whence it came was much wind, for commonly before any great Storm the Sea will come that way. Now if the Ship may run on ſhore in oſe or mud ſhe may eſcape, or Billage on a rock, or Anchors flook, repair her leak, but if ſhe ſplit or ſink, ſhe is a wrack. But ſeeing the Storm decreaſeth, let us try if ſhe will endure the **Hullock** of a Sail, which ſomtimes is a peice of the Miſen Sail or ſome other little Sail, part opened to keep her head to the Sea, but if yet ſhe would weather coile, we will looſe a Hullock of her fore-Sail, and put the Helm a weather, and it will bring her head where her ſtern is; courage my hearts. A head Sea. Hullock.

It clears up, ſet your fore Sail; Now it is fair weather out with all your Sails, go **Larg** or **Lask**, that is, when we have a freſh gale, or fair wind, and all Sails drawing. But for more haſte unparrel the Miſen-Yard and lanch it, and the Sail over her Lee-quarrter, and fit Gives at the further end to keep the Yard ſteady, and with a Boom, Boom it out; this we call a **Gooſe wing**. Who is at Helm there? Sirra, you muſt be amongſt the Points; Well Maſter the Channel is broad enough; yet you cannot ſteer betwixt a pair of ſheats; Thoſe are words of mockery betwixt the Gunner and the Stearſman. But to proceed. Large. Laskes. Gooſewing.

Get your Larboard Tackes aboard, hale off your Starboard ſheats, keep your courſe upon the Point you are directed. Port, he will lay her by the Lee; the ſtays, or backſtays, that is, when all the Sails flutter in the wind, and are not kept full, that is full of wind, they fall upon the Maſt and Shrowds, ſo that the Ship goes a drift upon her broad ſide, fill the Sails, keep full, full and by. Make ready to Tack about, is for every man to ſtand to handle the Sails and ropes they muſt hale. Tack about is to bear up the Helm and that brings her to ſtay all her Sails lying flat againſt the Shrowds, then as ſhe turns we ſay ſhe is payed, then let riſe your Lee tacks, and hale off your Sheats, and trim all your Sails as they were before, which is caſt off that Boling which was the weather-Boling, and hale up taut the other. So all your Sheats, Braces, and Tacks are trimmed by a wind as before. To belay, is to make faſt the ropes in their proper places. **Round in**, is when the wind larges, let riſe the main-tack and fore-tack, and hale aft the fore Sheat to the Cats-head, and the main Sheat to the cubbridge head, this is **Rounding in**, or **Rounding aft** the Sail; the Sheets being there they hale them down to keep them firm from flying up with a **Paſarado**, which is any rope wherewith we hale down the Sheats, blocks of the main or fore-Sail, when they are haled aft the clew of the main Sail to the Cubbridge head of the main Maſt, and the clew of the fore-Sail to the Cat-head; Do this when the Ships goes large.

Round in.

Rounding aft.

Paſarado.

Obſerve the height; that is, at twelve a clock to take the height of the Sun, or in the night the North Star, or in the forenoon and afternoon, if you miſs theſe by finding the **Azimuth** and **Almicanter**. **Dead-water** is the **Eddy water** follows the ſtern of the Ship, not paſſing away ſo quickly as that ſlides by her ſides. The **Wake** of a Ship is the ſmooth water a ſtern, ſhewing the way ſhe hath gone in the Sea, by this we judge what way ſhe doth make, for if the wake be right a ſtern, we know ſhe makes good her way forwards; but if to Lee-ward a point or two, we then think

Obſerve.

Dead-water.

The Wake.

think to the Lee-ward of her course, but she is a nimble Ship, that in turning or tacking about will not fall to the Lee ward of her wake when she hath weathered it. **Dismbogue** is to pass some narrow straight or currant into the main Ocean out of some great Gulf or Bay. A **Drift** is any thing floating in the Sea that is of wood. **Rock-weed** doth grow by the shore, and is a sign of Land, yet it is oft found far in the Sea. Lay the Ship by the Lee to trie the **Dip-sea line**, which is a small line, some hundred and fifty fathome long, with a long plummet at the end, made hollow, wherein is put tallow, that will bring up any gravel; which is first marked at twenty fathome, and after increased by tens to the end; and those distinguished by so many small knots upon each little string that is fixed at the mark thorow the Strouds or midst of the line, shewing it is so many times ten fathome deep, where the **Plummet** doth rest from drawing the line out of your hand; this is only used in deep waters when we think we approach the shore, for in the Main Sea at 300. fathomes we find no bottom. Bring the Ship to rights, that is, again under Sail as she was; some use a **Log-line**, and a minute glass to know what way she makes, but that is so uncertain, it is not worth the labour to try it.

Dismbogue.
A drift.
Rockweed.
Dipsea-line.
Plummet.
Log-line.

One to the Top to look out for **Land**, the man cries out **Land to**; which is just so far as a **Kenning**, or a man may discover, descry, or see the Land. And to **Lay a Land** is to Sail from it, just so far as you can see it. A **good Land fall** is when we fall just with our reckoning, if otherwise a **Bad Land fall**; but however how it bears, set it by the Compass, and bend your Cables to the Anchors, A **Head-Land**, or a **Point of Land** doth lie further out at Sea than the rest. **A Land mark**, is any Mountain, Rock, Church, Windmil or the like, that the Pilot can know by comparing one by another how they bear by the Compass. **A Reach** is the distance of two Points so far as you can see them in a right line, as *White-Hall* and *London-bridg*, or *White-Hall* and the end of *Lambeth* towards *Chelsey*. Fetch the

Land to.
Kenning.
To lay a land.
Good land.
fall.
Bad land fall.
A head land.
A Point.
Land mark.
To raise a land.
To make land.
A Reach.

sounding-line. **Sounding-line**, this is bigger than the Dipſie-line, and is marked of two fathom next the lead with a piece of black leather, at three fathom the like, but ſlit; at 5 fathom with a piece of white cloth; at 7 fathom with a piece of red in a piece of white leather; at 15 with a white cloth, *&c.* **The** The Lead. **ſounding lead** is ſix or ſeven pound weight, and near a foot long, he that doth heave this lead ſtands by the horſe, or in the chains, and doth ſing fathom by the mark 5. 0. and a **ſhaftment** leſs, 4. 0. this is to find where the Ship may Foul water. ſail by the depth of the water. **Foul-water** is when ſhe comes into ſhallow water where ſhe raiſes the ſand or oſe with her way, yet not touch the ground, but ſhe cannot feel her helm ſo well as in deep water.

When a Ship ſails with a large wind towards the land, Bear in. or a fair wind into a harbour, we ſay ſhe **Bears in** with the land or harbour. And when ſhe would not come neer the land, but goeth more Room-way then her courſe, we ſay Bear off ſhe bears off; but a Shipboard, **Bear off** is uſed to every Bear up. thing you would thruſt from you. **Bear up** is to bring the Hold off. Ship to go large or before the wind. To **Hold off** is when we heave the Cable at the Capſtern, if it be great and ſtiffe, Surges. or ſlimy with oſe, it ſurges or ſlips back unleſs they keep it cloſe to the whelps, and then they either hold it faſt with nippers, or brings it to the Jears Capſtern, and this is called Holding off. As you approach the ſhore, ſhorten your Sails, when you are in Harbour take in your Sails, and come to an anchor, wherein much judgement is required.

Neale to. To know well the ſoundings, if it be **Neale to**, that is, deep water cloſe aboard the ſhore, ſhallow, or if the Lee under the weather ſhore, or the Lee ſhore be ſandy, clay, oſie, or fowl and rocky ground, but the Lee ſhore all men would A Road. ſhun that can avoid it. Or **a Road** which is an open place neer Offing. the ſhore. Or, the **Offing** which is the open Sea from the ſhore, or the middeſt of any great ſtream is called the offing. Land locked. **Land-lockt**, is when the land is round about you.

To Ride. Now the Ship is ſaid **to Ride**, ſo long as the Anchors do Ride a great hold and comes not home. **To Ride a great Road** is when Roade. the

the wind hath much power. They will ſtrike their Top-Maſts, and the Yards alongſt Ships, and the deeper the water is, it requires more Cable; when we have rid in any diſtreſs we ſay **we have rid Hawſe full**, becauſe the water broke into the Hawſes, To **ride betwixt wind and tide**, is **when the wind and tide are contrary and of equal power**, which will make her rowle extreamly, yet not ſtrain much the Cable. To **ride thwart** is to ride with her ſide to the tide, and then ſhe never ſtrains it. To **ride apike** is to pike your Yards when you ride amongſt many Ships. To **ride croſſe** is to hoiſe the Main and fore-Yards to the hounds, and topped alike. When the water is gone and the Ship lies dry, we ſay ſhe is **Sewed**; if her head but lie dry, ſhe is **Sewed a head** but if ſhe cannot all lie dry, ſhe cannot **Sew** there. **Water born** is when there is no more water then will juſt bear her from the ground. The **water line** is to that End or place ſhe ſhould ſwim in when ſhe is loaded.

Ride a ſtreſs.
Ride betwixt. wind and tide.
Ride thwart tide.
Ride a pike.
Ride croſſe.
Sewed.
Sew.
Water born.
Water line.

Laſtly, to **Moar** a Ship is to lay out her anchors as is moſt fit for her to ride by, and the ways are divers; as firſt, to Moar a fair Berth from any annoiance. To **Moar a croſſe** is to lay one anchor to one ſide of the ſtream, and the other to the other right againſt one another, and ſo they bear equally Ebb and Flood. To **Moar alongſt** is to lay an anchor amidſt the ſtream ahead, and another a ſtern, when you fear driving a ſhore. **Water ſhot** is to moar quartering betwixt both nether croſs, nor alongſt the tide. In an open road they will moar that way they think the wind will come the moſt to hurt them. To **Moar a Proviſo**, is to have one anchor in the river, and a hawſer a ſhore, which is moared with her head a ſhore; otherwiſe two Cables is the leaſt and four Cables the beſt to moar by.

To Moare.
Moar croſſe.
Moar alongſt.
Water ſhot.
Moar Proviſo.

CHAP.

CHAP. X.

Proper terms for the Winds, Ebbs, Floods, *and* Eddies, *with their definitions, and an estimate of the* Depth *of the* Sea, *by the* Height *of the* Hils *and the largeness of the* Earth.

A Calm. A Breeze. Turnado. A fresh Gale. A Loom. gale. Eddy-wind. It over blows. A Gust. A Spout. A whirl-wind. A Storm.

WHen there is not a breath of wind stirring, it is **A Calm** or a stark Calm. **A Breeze** is a wind blows out of the Sea, and commonly in fair weather beginning about nine in the morning, and lasteth till neer night; so likewise all the night it is from the shore, which is called a **Turnado**, or a Sea turn, but this is but upon such coasts where it bloweth thus most certainly, except it be a storm, or very foul weather, as in *Barbary*, *Ægypt*, and the most of the Levant. We have such Breezes in most hot countrys in Summer, but they are very uncertain. **A fresh Gale** is that doth presently blow after a calm, when the wind beginneth to quicken or blow. **A fair Loom Gale** is the best to Sail in because the Sea goeth not high, and we bear out all our Sails. A stiffe gale is so much wind as our Top-sails can endure to bear. An **Eddy-wind** is checked by the Sail, a Mountain, turning, or any such thing that makes it return back again. **It over blows** when we can bear no Top-sails. A flaw of wind is **A Gust** which is very violent upon a sudden, but quickly endeth. **A Spout** in the *West Indies* commonly falleth in those Gusts, which is, as it were, a small river falling entirely from the clouds, like out of our water Spouts, which make the Sea where it falleth rebound in flashes, exceeding high. **Whirle-winds** running round, and bloweth divers wayes at once. **A Storm** is known to every one not to be much

much leſs than a **tempeſt**, that will blow down Houſes, and Trees up by the roots. A **Mounſoune** is a conſtant wind in the *Eaſt Indies*, that bloweth always three Months together one way, and the next three Months the contrary way. A **Hericano** is ſo violent in the *Weſt-Indies*, it will continue three, four, or five weeks, but they have it not paſt once in five, ſix, or ſeven years; but then it is with ſuch extremity, that the Sea flies like rain, and the waves ſo high, they over-flow the low Grounds by the Sea, inſomuch, that Ships have been driven over tops of high Trees there growing, many Leagues into the Land, and there left, as was Captain *Francis Nelſon* an *Engliſhman*, and an excellent Seaman for one.

A Tempeſt.
A Mounſoune.
A Hericane.

We ſay a calm Sea, or **Becalmed**, when is ſo ſmooth the Ship moves very little, and the men leap over board to ſwim. **A Rough Sea** is when the waves grow high. **An overgrown Sea** when the **Surges** and **Billows** go higheſt. The **Rut** of the Sea, where it doth daſh againſt any thing. And the **Roaring of the Sea** is moſt commonly obſerved a ſhore, a little before a ſtorm or after a ſtorm.

Becalmed.
A Rough Sea.
An overgrown Sea.
Surges.
The Rut of the Sea.
The roaring of the Sea.

Flood is when the water beginneth to riſe, which is **young Flood** as we call it, then *Quarter-flood*, *Half-flood*, *Full-Sea*, *Still-water*, or *High-water*. So when it **Ebbs**, *Quarter-ebb*, *Half-ebb*, *three Quarter-ebb*, *Low-water*, or *Dead Low water*, every one doth know; and alſo that as at a *Spring-tide* the *Sea* or *water* is at the *higheſt*, ſo at a *Neape-tide* it is at the *loweſt*. This word **Tide**, is common both to *Flood* and *Ebb*; for you ſay as well *Tide of Ebb*, as *Tide of Flood*, or a *windward Tide*, when the *Tide runs againſt the Stream*, as a *Leeward Tide*, that is, when the wind and the Tide goeth both one way, which makes the water as *ſmooth* as the other *rough*. To *Tide over to a place*, is to go over with the Tide of Ebb or Flood, and ſtop the contrary by Anchoring till the next Tide, thus you may work againſt the wind if it over-blow not. A Tide-gate is where the Tide runneth ſtrongeſt. It flows Tide and half-Tide, that is, it will be half-Flood by the ſhore, before it begin to flow in the

Floods and Ebbs.
A Tide of Ebb
A Tide of Flood.
A windward Tide.
A Leeward Tide.
To Tide over.
A Tide-gate.
Tide and half-Tide.

Eddie Tide.

the Channel; for although the Tide of Flood run aloft, yet the Tide of Ebb runs close by the ground. An **Eddie**-Tide is where the water doth run back contrary to the Tide, that is, when some Headland or great Point in a River hindereth the free passage of the stream, that causeth the water on the other side the Point to turn round by the shore as in a Cirle, till it fall into the Tide again.

As touching the reasons of Ebbs and Floods, and to know how far it is to the bottom of the deepest place of the Sea, I will not take upon me to discourse of; as knowing the same to be the secrets of God unrevealed to man: only I will set down a Philosophical speculation of divers mens opinions touching the depth of the Sea; which I hope will not be thought much impertinent to the subject of this Book by the Judicious Reader.

The heigth of Mountains perpendicular.

Fabianus in *Pliny*, and *Cleomides* conceived the depth of the Sea to be fifteen Furlongs, that is, a Mile and ⅞ parts. *Plutarch* compared it equal to the higheſt Mountains; *Scaliger* and others conceited the Hills far surpassed the deepness of the Sea, and that in few places it is more than a hundred paces in depth, it may be he meant in some narrow Seas, but in the main Ocean experience hath taught us it is much more than twice so much, for I have sounded 300 fathom, yet found no ground. *Eratosthenes* in *Theon* that great Mathematician writeth the higheſt Mountain perpendicular is but ten Furlongs, that is, one Mile and a quarter. Also *Dicæarcus* affirmeth this to be the height of the Hill *Pelius* in *Thessalia*, but *Xenagoras* in *Plutarch* observed the height of *Olympius* in the same region to be twenty paces more, which is 1270. paces, but surely all those mean only those Mountains in or about *Greece*, where they lived and were best acquainted; but how these may compare with the *Alpes*, in *Asia*, *Atlas* in *Africa*, *Caucasus* in *India*, the *Andes* in *Peru*, and divers others hath not yet been examined.

The heigth of the Hills compared with the Superficies of the Earth and depth of the Sea.

But whatsoever the Hills may be above the Superficies of the Earth, many hold opinion the Sea is much deeper, who sup-

ſuppoſe that the Earth at the firſt framing was in the ſuperficies regular and Spherical, as the Holy Scripture directs us to believe; becauſe the water covered and compaſſed all the face of the Earth, alſo that the face of the Earth was equal to that of the Sea. *Damaſcene* noteth, that the unevenneſs and irregularity, which now is ſeen in the Earth's Superficies, was cauſed by taking ſome parts out of the upper face of the Earth in ſundry places to make it more hollow, and lay them in other places to make it more convex, or by raiſing up ſome part, and depreſſing others to make room and receit for the Sea, that mutation being wrought by the power of the word of the Lord, *Let the waters be gathered into one place, that the dry land may appear.* As for *Aquinas, Dionyſius, Catharianus*, and ſome Divines that conceited there was no mutation, but a violent accumulation of the waters, or heaping them up on high is unreaſonable; becauſe it is againſt nature, that water being a flexible and a ponderous body, ſo to conſiſt and ſtay it ſelf, and not fall to the lower parts about it; where in nature there is nothing to hinder it; or, if it be reſtrained ſupernaturally by the hand and bridle of Almighty God, leſt it ſhould overwhelm and drown all the Land, it muſt follow, that God even in the very inſtitution of Nature impoſed a perpetual violence upon Nature. And this withal, that at the Deluge there was no neceſſity to break up the Springs of the Deep, and to open the Cataracts of Heaven, and pour down water continually ſo many days and nights together, ſeeing the only withdrawing of that hand, or leting go of that bridle which reſtraineth the water, would preſently have overwhelmed all.

How all the Hills and dry land above the Superficies of the Sea hath made room for the Sea, therefore they are in equal height and depth.

But both by Scriptures, the experience of Navigators, and reaſon, in making eſtimation of the depth of the Sea, reckon not only the height of the Hills above the common Superficies of the Earth, but the height of all the dry Land above the Superficies of the Sea, becauſe the whole maſs of Earth that now appeareth above the waters, being taken as it were out of the places which the waters now poſſeſs,

must be equal to the place out of which it was taken; so consequently it seemeth, that the height or elevation of the one should answer the descending or depth of the other; and therefore in estimating the depth of the Sea, we consider not only the erection of the Hills above the ordinary land, but the advantage of the dry land above the Sea; which latter, I mean the height of the ordinary main-land, excluding the Hills, which properly answer the extraordinary Deeps and Whirl-pools in the Sea. The rest is held more in large Continents above the Sea, than that of the Hills is above the land.

That there is small difference betwixt the springs first rising out of the Earth, and their falling into the Sea.

For that the plain face of the dry land is not level, or equally distant from the Center, but hath a great descent towards the Sea, and a rising towards the midland parts, although it appear not plainly to the eye, yet to reason it is most manifest; because we find that part of the Earth the Sea covereth descendeth lower and lower towards the Sea. For the Sea, which touching the upper face of it, is known by nature to be level, and evenly distant from the Center, is observed to wax deeper and deeper, the further one saileth from the shore towards the main Ocean: even so in that part which is uncovered, the streamings of Rivers on all sides from the Midland parts towards the Sea, sliding from the higher to the lower, declareth so much; whose courses are some 1000. or 2000 miles, in which declination, *Pliny* in his derivation of water requireth one cubit of declining in 240 foot of proceeding. But *Columella*, *Vitruvius*, *Paladius*, and others, in their conduction of waters require somewhat less; namely, that in the proceeding of 200, foot forward, there should be allowed one foot of descending downward, which yet in the course of 1000. miles, as *Danubius*, *Volgha*, or *Indus*, &c. have so much or more, which will make five miles of descent in perpendicular account, and in the course of 2000. or more, as *Nilus*, *Niger*, and the River of the *Amazons* have ten miles or more of the like descent.

The determination of these questions.

These are not taken as rules of necessity, as though water could not run without that advantage, for that respect the con-

conveyers of waters in theſe times content themſelves with one Inch in 600. foot, as *Philander* and *Vitruvius* obſerved, but is rather under a rule of commodity for expedition and wholſomeneſs of water ſo conveyed, leſt reſting too long in Pipes it ſhould contract ſome unwholſome condition, or elſe through the ſlackneſs of motion, or long cloſeneſs, or baniſhment from the air, gather ſome aptneſs and diſpoſition to putrifie. Although I ſay, ſuch exceſs of advantage as in the Artificial conveyance of Waters the forenamed Authors require, be not of neceſſity exacted in the natural derivation of them, yet certain it is, that the deſcent of Rivers being continually, and their courſe long, and in many places ſwift, and in ſome places headlong and furious; the differences of height or advantage cannot be great betwixt the ſprings of the Rivers, and their outlets, betwixt the firſt riſing out of the Earth, and their falling into the Sea: unto which declivity of land, ſeeing the deepneſs of the Sea in proportion anſwer, as I before declared, and not only to the height of the Hills: it is concluded, that the deepneſs to be much more than the Philoſophers commonly reputed: and although the deepneſs of the *Sardinian* Sea, which *Ariſtotle* ſaith, was the deepeſt of the *Mediterranean*, recorded by *Poſidonius* in *Strabo*, to have been found but 1000. fathom, which is but a mile and a fifth part, and the greateſt breadth not paſt 600. miles: then ſeeing if in ſo narrow a Sea it be ſo deep, what may we eſteem the main Ocean to be, that in many places is five times ſo broad, ſeeing the broader the Seas are, if they be intire and free from Iſlands, they are anſwerably obſerved to be the deeper. If you deſire any further ſatisfaction, read the firſt part of *Purchas* his Pilgrimage, where you may read how to find all thoſe Authors at large. Now becauſe he hath taken near 100. times as much from me, I have made bold to borrow this from him, ſeeing he hath ſounded ſuch deep Waters for this our Ship to ſail in, being a Gentleman whoſe perſon I loved, and whoſe memory and vertues I will ever honour.

Note, the difference betwixt the ſprings of the Rivers, and their falling into the Sea is not great.

CHAP. XI.

Proper Sea terms belonging to the good *or* bad *condition of Ships, how to find them and amend them.*

A wholsome Ship.

A Ship that will try, hull, and ride well at Anchor; we call a **wholesome Ship.** A long Ship that draws much water will do all this, but if she draw much water, and be short, she may Hull well, but neither try nor ride well; if she draw little water and be long, she may try and ride well, but never Hull well, which is called an **unwholsome Ship.** The **Howsing** in of a Ship is when she is past the breadth of her bearing she is brought in narrow to her upper works: it is certain this makes her wholsome in the Sea without rowling, because the weight of her Ordnance doth counterpoise her breadth under water, but it is not so good in a Man of War, because it taketh away a great deal of her room, nor will her Tacks ever so well come aboard as if she were laid out aloft, and not **Flaring**, which is when she is a little Howsing in, near the water, and then the upper work doth hang over again, and is laid out broader aloft, this makes a Ship more roomy aloft for men to use their arms in, but Sir *Walter Rawleigh*'s proportion, which is to be proportionably wrought to her other work is the best, because the counterpoise on each side doth make her swim perpendicular or straight, and consequently steady, which is the best.

An unwholsome Ship.

Howsing a Ship.

Flaring.

If a Ship be narrow, and her bearing either not laid out enough or too low, then you must make her broader and her bearing the higher by ripping off the Planks two or three

three ſtrakes under water, and as much above, and put other Timbers upon the firſt, and then put on the Planks upon thoſe Timbers, this will make her bear a better Sail, but it is an hinderance to her Sailing, this is to be done when a Ship is **Crank-ſided**, and will bear no Sail, and is called **Furring**. Note alſo, that when a Ship hath a deep Keel it doth keep her from rowling. If ſhe be floaty and her Keel ſhallow, put on another Keel under the firſt to make it deeper, for it will make her hold more in the water, this we call **a falſe Keel**. Likewiſe if her Stem be too flat to make her cut water the better, and not **gripe**, which is when ſhe will not keep a wind well; fix another Stem before it, and that is called **a falſe Stem**, which will make her rid more way, and bear a better Sail. Alſo **the Run** of a Ship is as much to be regarded, for if it be too ſhort and too full below, the water comes but ſlowly to the Rudder, becauſe the force of it is broken by her breadth, and then to put a falſe Stem-poſt to lengthen her is the next remedy, but to lengthen her is better; for when a Ship comes off handſomely by degrees, and her Tuck doth not lie too low, which will hinder the water from coming ſwiftly to the Rudder, makes her ſhe cannot ſteer well, and they are called as they are, **a good run or a bad**. When a Ship hath loſt a piece of her Keel, and that we cannot come well to mend it, you muſt patch a new piece unto it, and bind it with a **Stirrup**, which is an Iron comes round about it, and the Keel up to the other ſide of the Ship, whereto it is ſtrongly nailed with Spikes. Her **Rake** alſo may be a defect, which is ſo much of the Hull, as by a perpendicular line the end of the Keel is from the ſetting on of the Stem, ſo much as is without that forward on, and in like manner the ſetting in of her Stem-Poſt. Your *Frenchmen* gives great Rakes forwards on, which makes her give good way, and keep a good wind, but if ſhe have not a full Bow, ſhe will pitch her Head extreamly in the Sea. If ſhe have but a ſmall Rake, ſhe is ſo bluff that the Seas meets her ſo ſuddenly upon the Bows ſhe cannot cut the water much, but the longer a Ship is, the fuller ſhould be her

Crank ſide.
Furring.
A falſe Keel.
Gripe.
A falſe Stem.
The Run.
A good Run.
A bad Run.
A Stirrup.
Her Rake.

Looke. her Bow, but the mean is the beſt. The **Looming** of a Ship is her proſpective, that is, as ſhe doth ſhew great or little: Her water-draught is ſo many foot as ſhe goes in the water, but the Ships that draw moſt water are commonly the moſt wholſome, but the leaſt draught goes beſt but rolls moſt,

Heeld. and we ſay a Ship doth **Heeld** on Starboard or Larboard, that is, to that ſide ſhe doth lean moſt.

Overſet. Overthrow. To **Overſet** or **overthrow** a Ship, is by bearing too much Sail you bring her Keel upwards, or on ſhore overthrow her by grounding her, ſo that ſhe falls upon one ſide; and we

Walt. Wall-reared. ſay a Ship is **walt** when ſhe is not ſtiff, and hath not Ballaſt enough in her to keep her ſtiff. And **Wall-reared** when ſhe is right built up, after ſhe comes to her bearing it makes her ill ſhapen and unſeemly, but it gives her within much room, and ſhe is very wholſome, if her bearing be well laid out. The Maſting of a Ship is much to be conſidered, and will much cauſe her to ſail well or ill, as I have related in the Ma-

Iron ſick. ſting a Ship. **Iron-ſick**, is when the Bolts, Spikes, or Nails are ſo eaten with ruſt they ſtand hollow in the Planks, and ſo makes her Leak, the which to prevent, they uſe to put Lead over all the Bolt-heads under water. Laſtly, the trimming of a Ship doth much amend or impair her ſailing, and ſo alter

Trim. her condition. To find her **Trim**, that is, how ſhe will ſail beſt; is by trying her ſailing with another Ship, ſo many Glaſſes trimmed a head, and ſo many a ſtern, and ſo many upon an even Keel; alſo the eaſing of her Maſts and Shrowds, for ſome Ships will ſail much better when they are ſlack than when they are taut.

CHAP.

CHAP. XII.

Conſiderations for a Sea Captain *in the choice of his Ship, and in placing his* Ordnance. *In giving* Chaſe, Boarding, *and entring a* Man of War *like himſelf, or a defending* Merchant-man.

IN Land-ſervice we call a Man of War a Souldier, either on Foot or Horſe, and at Sea a Ship, which if ſhe be not as well built, conditioned, and provided, as near fitting ſuch an Imployment, as may be, ſhe may prove (either) as a Horſeman that knoweth not how to hold his Reins, keep his ſeat in his ſaddle and ſtirrups, carry his Body, nor how to help his Horſe with leg and ſpur in a curvet, gallop, or ſtop; or as an excellent Horſeman that knoweth all, this, mounted upon a Jade that will do nothing, which were he mounted according to his Experience, he would do more with that one, than half a dozen of the other, though as well provided as himſelf. But I confeſs, every Horſeman cannot mount himſelf alike, neither every Seaman ſhip himſelf as he would, I mean not for outward Ornament, which the better they are, the leſs to be diſliked; for there cannot be a braver ſight than a Ship in her Bravery, but of a competent ſufficiency, as the buſineſs requireth. But were I to chuſe a Ship for my ſelf, I would have her ſail well, yet ſtrongly built, her Decks fluſh and flat, and ſo roomy that men might paſs with eaſe; her Bow and Chaſe ſo Gally like contrived, ſhould bear as many Ordnance as with conveniency ſhe could, for that always cometh moſt to fight, and ſo ſtiff, ſhe ſhould bear a ſtiff Sail, and bear out her lower Tier in any reaſonable weather; neither ſhould her Gun room be unprovided; not manned like a Merchant-man, which if they

How to chuſe a Ship fit to make a Man of War.

they be double manned, that is, to have twice ſo many men as would ſail her, they think it is too many, in regard of the charge, yet to ſpeak true, there are few Merchant Ships in the World do any way exceed ours. And thoſe men they entertain in good Voyages, have ſuch good Pay, and ſuch acquaintance one with another in ſhipping themſelves, that thirty or fourty of them would trouble a Man of War with three or four times their number manned with Preſt Men, being half of them ſcarce hale-Boulings. Yea, and many times a Pirat, who are commonly the beſt manned, but they fight only for Wealth, not for Honour nor Revenge, except they be extremely conſtrained. But ſuch a Ship as I have ſpoken of, well manned with rather too many than too few, with all ſufficient Officers, Shot, Powder, Victual, and all their apurtenances, in my opinion, might well paſs muſter for a time of War.

His Reward that firſt deſcries a Ship, or enters a Prize.

Now being at Sea, the Tops are ſeldom without one or other to look out for Purchaſe, becauſe he that firſt deſcries a Sail, if ſhe prove Prize, is to have a good Sute of Apparel, or ſo much Money as it ſet down by order, for his Reward; as alſo he that doth firſt enter a Ship, there is a certain Reward allowed him: When we ſee a Ship alter her courſe, and uſeth all the means ſhe can to fetch you up, you are the Chaſe, and he the Chaſer. In giving chaſe, or chaſing, or to eſcape being chaſed, there is required an infinite Judgment and Experience, for there is no Rule for it; but the ſhorteſt way to fetch up your Chaſe, is the beſt. If you be too Lee-ward, get all your Tacks aboard, and ſhape your Courſe as he doth, to meet him at the neareſt Angle you can, then he muſt either alter his Courſe, and Tack as you Tack as near the wind as he can lie, to keep his own till night, and then ſtrike a Hull, that you may not deſcry him by his Sails, or do his beſt to loſe you in the dark; for look how much he falls to Lee ward, he falls ſo much in your way. If he be right a-head of you, that is called a Stern-chaſe, if you weather him, for every man in chaſing doth ſeek to get the Weather, becauſe you cannot board him, except you weather him, he will lask,

How to give chaſe, and eſcape the Chaſer.

or

or go large, if you gather on him that way, he will try you before the Wind; then if your Ordnance cannot reach him, if he can out-ſtrip you, he is gone. But ſuppoſe you are to Windward, if he clap cloſe by a wind, and there goes a-head-Sea, and yours a Lee-ward Ship, if you do the like your Ship will ſo bear againſt the Sea, ſhe will make no way; therefore you muſt go a little more large, though you chaſe under his Lee till you can run a head.

Board and **Board**, is when two Ships lie together ſide by ſide, but he that knoweth how to defend himſelf, and work well, will ſo cun his Ship, as force you to enter upon his quarter, which is the higheſt part of the Ship, and but the Miſen Shrowds to enter by, from whence he may do you much hurt with little danger, except you fire him, which a Pirat will never do, neither ſink you, if he can chuſe, except you be able to force him to defend himſelf. But in a Sea-fight we call Boarding, in Boarding where we can; the greateſt advantage for your Ordnance, is to board him thwart the Hawſe, becauſe you may uſe all the Ordnance you have on one ſide, and ſhe only them in her Prow; but the beſt and ſafeſt **boarding** for **entring**, is on the Bow, but you muſt be careful to clear the Decks with burning Granadoes, Fire-pots, Pouches of Powder, to which give fire by a Gun-powder Match, to prevent Trains to the **Powder cheſt**, which are long Boards joyned like a Triangle, with divers broad ledges on either ſide, wherein lieth as many Pebble ſtones or Beatch as can there lie; thoſe being fired, will make all clear before them. Beſides, in an extremity a man would rather blow up the quarter-Deck, half-Deck, Fore-caſtle, or any thing, than be taken by him he knows a mortal Enemy; and commonly there are more men loſt in entering, if the Chaſe ſtand to her defence, in an inſtant, than in a long Fight, board and board, if ſhe be provided of her cloſe Fights. I confeſs, the charging upon Trenches, and the entrances of a Breach in a Rampire, are Attempts as deſperate as a man would think could be performed, but he that hath tried him[illegible] in the entring a reſting Ship as I have done both [illegible]

Board and board.

Boarding and entring a Ship

Powder-cheſts

other, he would ſurely confeſs there is no ſuch dangerous Service aſhore, as a reſolved reſolute Fight at Sea. A Ships cloſe Fights, are ſmall ledges of Wood laid croſs one another like the Grates of Iron in a Priſons-window, betwixt the main Maſt, and the Fore-maſt, and are called Gratings, or Nettings, as is ſaid, which are made of ſmall Ropes, much in like manner, covered with a Sail; the which to undo, is to heave a Kedger, or fix a Grapling into them, tied in a Rope, but a Chain of Iron is better, and ſheering off will tear it in pieces, if the Rope and Anchor hold; ſome have uſed Sheer-hooks, which are Hooks like Sickles fixed in the ends of the Yards-arms, that if a Ship under ſail come to board her, thoſe Sheers will cut her Shrowds, and ſpoil her Tackling; but they are ſo ſubject to break their own Yards, and cut all the Ropes comes from the Top-ſails, they are out of requeſt. To conclude, if a Ship be open, preſently to board her, is the beſt way to take her. But if you ſee your Chaſe ſtrip himſelf into fighting Sails, that is, to put out his Colours in the Poop, his Flag in the Main-top, his Streamers or Pendants at the ends of his Yards-arms, furl his Spret-ſail, pike his Miſen, and ſling his Main-yard, provide your ſelf to fight. Now becauſe I would not be tedious in deſcribing a Fight at Sea, I have troubled you with this ſhort Preamble, that you may the plainlier underſtand it.

Evident ſigns that a Chaſe will fight.

CHAP.

CHAP. XIII.

How to Manage a Fight at Sea, *with the proper* Terms *in a* Fight *largely expreſſed, and the ordering of a* Navy at Sea.

FOR this Maſter-piece of this Work, I confeſs I might do better to leave it to every particular mans conceit as it is, or thoſe of longer practice or more experience, yet becauſe I have ſeen many Books of the Art of War by Land, and never any for the Sea, ſeeing all men ſo ſilent in this moſt difficult ſervice, and there are ſo many young Captains, and others that deſire to be Captains, who know very little, or nothing at all to any purpoſe, for their better underſtanding I have proceeded thus far; now for this that follows, what I have ſeen, done, and conceived by my ſmall experience, I refer me to their friendly conſtructions, and well adviſed conſiderations.

Many Books of the Art of War for the Land, none for the Sea.

A Sail, how bears ſhe or ſtands ſhe, to Windward or Leeward; ſet him by the Compaſs; he ſtands right a head, or on the Weather-Bow, or Lee Bow, let flie your colours if you have a conſort, elſe not. Out with all your Sails, a ſteady man to the helm, ſit cloſe to keep her ſteady, **give him chaſe** or fetch him up; he holds his own, no, we gather on him. Captain, out-goes his Flag and Pendants, alſo his **waſte Clothes** and **Top-armings**, which is a long red Cloth about three quarters of a yard broad, edged on each ſide with Calico or white Linnen Cloth, that goeth round about the Ship on the out-ſides of all her upper works fore and aft, and before the Cubbridge heads, alſo about the fore and main Tops, as well for the countenance and grace of the Ship, as to cover the men from being ſeen, he furles and ſlings his

To give chaſe.

Waſte Clothes. Top-armings.

Main-yard, in goes his Spret-ſail. Thus they uſe to ſtrip themſelves into their **ſhort Sails**, or **Fighting Sails**, which is only the Fore ſail, the Main and Fore top Sails, becauſe the reſt ſhould not be fired nor ſpoiled; beſides they would be troubleſome to handle, hinder our ſights and the uſing our Armes; he makes ready his cloſe Fights fore and aft.

Fighting Sails.

To hale a Ship.

How to begin a Fight.

Maſter, how ſtands the Chaſe? Right on head I ſay; Wall we ſhall reach him by and by; What's all ready? Yea, yea, every man to his Charge, dowſe your Top-ſail to ſalute him for the Sea, hale him with a noiſe of Trumpets: Whence is your Ship? Of *Spain*: Whence is yours? Of *England*: Are you a Merchant, or a Man of War? We are of the Sea. He waves us to Leeward with his drawn Sword, calls amain for the King of *Spain*, and ſprings his Loufe, give him a Chaſe-piece with your Broad ſide, and run a good berth a head of him; Done, done. We have the wind of him, and he tacks about, Tack you about alſo, and keep your Loufe, be yare at the helm, edg in with him, give him a volley of ſmall ſhot, alſo your Prow and Broad-ſide as before, and keep your Loufe; He pays us ſhot for ſhot; Well, we ſhall requite him; What are you ready again? Yea, yea. Try him once more, as before: Done, done: Keep your Loufe, and load your Ordnance again: Is all ready? Yea, yea; edg in with him again, begin with your Bow pieces, proceed with your Broad-ſide, and let her fall off with the wind, to give her alſo your full Chaſe, your Weather-Broadſide, and bring her round that the Stern may alſo diſcharge, and your Tacks cloſe aboard again: Done, done, the wind veers, the Sea goes too high to board her, and we are ſhot through and through, and between wind and water. Try the Pump, bear up the Helm; Maſter, let us breath and refreſh a little, and ſling a man over-board to ſtop the Leaks; that is, to truſs him up about the middle in a piece of Canvas, and a rope to keep him from ſinking, and his arms at liberty, with a Malet in the one hand, and a Plug lapped in Okum, and well Tarred in a Tarpawling-clout in the other, which he will quickly beat into the hole or holes the Bullets made; What cheer Mates?

How to ſling a man over-Board.

is

is all well? All well, all well, all well; Then make ready to bear up with him again, and withal your great and ſmall ſhot charge him, and in the ſmoke board him thwart the Hawſe, on the Bow, mid-Ships, or rather than fail, on his Quarter, or make faſt your Graplings if you can to his cloſe Fights and ſhear off. Captain, we are fowl on each other, and the Ship is on fire, cut any thing to get clear, and ſmother the fire with wet Clothes. In ſuch a caſe they will preſently be ſuch friends, as to help one the other all they can to get clear, leſt they both ſhould burn together and ſink; and if they be generous, the fire quenched, drink kindly one to another; heave their Cans over-board, and then begin again as before.

A conſultation and direction in a Sea-fight, and how they bury their dead.

Well, Maſter, the day is ſpent, the night draws on, let us conſult. Chirurgion, look to the wounded, and wind up the ſlain, with each a weight or Bullet at their Heads and Feet to make them ſink, and give them three Guns for their Funerals. Swabber, make clean the Ship; Purſer record their Names: Watch, be vigilant to keep your berth to windward that we loſe him not in the night: Gunners, ſponge your Ordnance; Souldiers, ſcowre your Pieces: Carpenters, about your Leaks; Boatſwain and the reſt, repair the Sails and Shrowds; and Cook, you obſerve your directions againſt the Morning watch: Boy, Holla Maſter, Holla, is the Kettle boiled? Yea, yea: Boatſwain, call up the men to Prayer and Break-faſt.

A preparation for a freſh Charge.

Boy, fetch my Cellar of Bottels, a Health to you all fore and aft, courage my hearts for a freſh Charge; Gunners, beat open the Ports, and out with your lower Tire, and bring me from the Weather ſide to the Lee, ſo many Pieces as we have Ports to bear upon him. Maſter, lay him aboard Louſe for Louſe; Mid-ſhips men, ſee the Tops and Yards well Manned, with Stones, Fire pots, and Braſs-bails, to throw amongſt them, before we enter, or if we be put off, charge them with all your great and ſmall ſhot, in the ſmoke let us enter them in the Shrowds, and every Squadron at his beſt advantage; ſo ſound Drums and Trumpets, and St. *George* for *England*.

They

How a prize doth yeild, and how to entertain him Seaman like.

They hang out a Flag of Truce, hale him a main, abaſe, or take in his Flag, ſtrike their Sails and come aboard with their Captain, Purſer and Gunner, with their Commiſſion, Cocket, or Bills of Loading. Out goes the Boat, they are lanched from the Ship-ſide, entertain them with a general cry, God ſave the Captain and all the Company, with the Trumpets ſounding, examine them in particular, and then conclude your conditions, with feaſting, freedom, or puniſhment, as you find occaſion; but always have as much care to their Wounded as your own, and if there be either young Women or Aged-men, uſe them nobly, which is ever the nature of a generous diſpoſition. To conclude, if you ſurprize him, or enter perforce, you may ſtow the men, rifle, pillage, or ſack, and cry a Prize.

How to call a Counſel of War, and order a Navy at Sea.

To call a Council of War in a Fleet: There is your Council of War to manage all buſineſſes of import, and the Common Council for matters of ſmall moment, when they would have a meeting, where the Admiral doth appoint it; if in the Admiral, they hang but a Flag in the main-Shrowds; if in the Vice-Admiral, in the Fore-ſhrowds; if in the Rear-Admiral, in the Miſen: If there be many Squadrons, the Admiral of each Squadron upon ſundry occaſions doth carry in their main-Tops, Flags of ſundry Colours, or elſe they are diſtinguiſhed by ſeveral Pendants from the Yard-arms; every night or morning they are to come under the Lee of the Admiral to ſalute him and know his pleaſure, but no Admiral of any Squadron is to bear his Flag in the main Top, in the preſence of the Admiral-General, except the Admiral come aboard of him to Council, to Dinner, or Collation, and ſo any Ship elſe where he ſo reſideth during that time, is to wear his Flag in the main Top. They uſe to martial or order thoſe Squadrons in ranks like Manaples, which is four ſquare, if the Wind and Sea permits, a good berth or diſtance from each other, that they becalm not one another, nor come not foul of each other; the General commonly in the midſt, his Vice Admiral in the front, and his Reer Admiral in the Reer; or otherwiſe like a half Moon, which

which is two Squadrons like two Triangles for the two Horns, and ſo the reſt of the Squadrons behind each other a good diſtance, and the General in the midſt of the half Circle, from whence he ſeeth all his Fleet, and ſendeth his directions, as he finds occaſion to whom he pleaſeth.

Now between two Navies they uſe often, eſpecially in a Harbour or Road where they are at Anchor, to fill old Barks with Pitch, Tarr, Train-oyl, Lynſeed-oyl, Brimſtone, Rozin, Reeds, with dry Wood, and ſuch Combuſtible things, ſometimes they link three or four together in the night, and put them adrift as they find occaſion. To paſs a Fort ſome will make both Ships and Sails all black, but if the Fort keep but a fire on the other ſide, and all the pieces point blank with the fire, if they diſcharge what is betwixt them and the fire, the ſhot will hit, if the Rule be truly obſerved; for when a Ship is betwixt the fire and you ſhe doth keep you from ſeeing it till ſhe be paſt it. To conclude there is as many ſtratagems, advantages, and inventions to be uſed as you find occaſions, and therefore experience muſt be the beſt Tutor.

CHAP. XIV.

How they divide their ſhares in a man of War, what Books and Inſtruments are fit for a Sea man, with divers advertiſements for Sea men, and the uſe of the Petty Tally.

THe Ship hath one third part. The Victualler the other third. The other third part is for the Company, and this is ſubdivided thus in ſhares.

		Shares.
The Captain hath	10	In ſome but 9
The Lieutenant	9	or as he agreeth with the Captain.
The Maſter	8	In ſome but 7
The Mates	7	5
The Chyrurgion	6	3
The Gunner	6	5
The Boatſwain	6	5
The Carpenter	6	5
The Trumpeter	6	5

The 4 quarter Maſters 5 — a piece, or — 4
The Cooper — 5 — 4
The Chyrurgions Mate 5 — 4
The Gunners Mate — 5 — 4
The Carpenters Mate — 5 — 4
The Corporal — 4 — 3
The quarter Gunners — 4 — 3
The Trumpeters Mate — 3 — 3 1/2
The Steward — 4 — 3
The Cook — 4 — 3
The Coxſwain — 4 — 3
The Swabber — 4 — 3

In *Engliſh* Ships they ſeldom uſe any Marſhal, whoſe ſhares amongſt the *French* is equal with the Boatſwains, all the reſt of the Younkers, or Fore-maſt-men according to their deſerts, ſome three, ſome two and a half, ſome one and a half, and the Boys one, which is a ſingle ſhare, or one and a half, or as they do deſerve.

Now the Maſter, or his right hand Mate, the Gunner, Boatſwain, and four Quarter Maſters do make the ſhares, not the Captain who hath only this priviledge, to take away half a ſhare, or a whole ſhare at moſt, to give from one to another as he beſt pleaſeth.

For to learn to obſerve the Altitude, Latitude, Longitude, Amplitude, the Variation of the Compaſs, the Suns Azimuth and Almicanter, to ſhift the Sun and Moon, and know the Tides, your Rombs, prick your Card, ſay your Compaſs, get ſome of theſe Books, but practice is the beſt.

Maſter *Wrights* Errors of Navigation.
Maſter *Taps* Sea-mans Kalendar.
The Art of Navigation.
The Sea Regiment.
The Sea-mans Secret.
Maſter *Gunters* Works.
The Sea-mans Glaſs for the Scale.
The New Attractive for Variation.
Maſter *Wright* for uſe of the Globe.
Maſter *Hewes* for the ſame.

Inſtruments fitting for a Sea-man,

Compaſſes ſo many Pair and Sorts as you will, an *Aſtrolabe Quadrant*, a *Croſs-ſtaff*, a *Back-ſtaff*, an *Aſtrolabe*, a *Nocturnal.*

Advertiſements for young Commanders, Captains, and other Officers.

A young Gentleman that deſires command at Sea, ought well to conſider the condition of his Ship, Victuals, and Company, nor muſt there be more Learners than Sailers, how ſlightly ſoever many eſteem Sailers, for all the work to ſave Ship, Goods and lives muſt lie upon them, eſpecially in foul weather, then their labour, hazard, wet and cold is ſo incredible I cannot expreſs it. It is not then the number of them that here can ſay at home, what I cannot do I can quickly learn, and what a great matter it is to Sail a Ship, or go to Sea; ſurely thoſe for ſome time will do more trouble than good, I confeſs it is moſt neceſſary ſuch ſhould go, but not too many in one Ship, for if the labour of threeſcore ſhould lie upon thirty, (as many times it doth) they are ſo over-charged with labour, bruiſes, and over-ſtraining themſelves they fall Sick of one diſeaſe or other, for there is no dalying nor excuſes with Storms, Guſts, over-grown Seas, and Lee-ſhores, and when their victuals is putrified it endangers all: Men of all other profeſſions in Lightning, Thunder, Storms and Tempeſts, with Rain and Snow, may ſhelter themſelves in dry houſes by good fires, but thoſe are the chief times Seamen muſt ſtand to their Tackling, and attend with all diligence their greateſt labour upon the Decks. Many ſuppoſe any thing is good enough to ſerve men at Sea, and yet nothing ſufficient for them aſhore, either for their healths, for their eaſe, or eſtate; A Commander at Sea ſhould do well to think the contrary, and provide for himſelf and company in like manner; alſo ſeriouſly to conſider what will be his charge to furniſh himſelf at Sea with Bedding, Linnen, Arms, and Apparel, how to keep his Table aboard, and his expences on ſhore, and provide his **Petty-Tally**, which is a competent proportion (according to your number) of theſe particulars following.

The Petty-Tally.

Fine wheat flower cloſe and well packed, *Rice*, *Currants*, *Sugar*,

gar, Prunes, Cynamon, Ginger, Pepper, Cloves, green-Ginger, Oil, Butter, Holland-Cheese, or old *Cheese, Wine, vinegar, Canary Sack, Brandy*, the best *Wines*, the best *Water*, the juyce of *Limmons* for the scurvy, white-Bisket, *Oatmeal, Gammons* of *Bacon, dryed Neats tongues*, *Beef* packed up in *Vineger*, Legs of *Mutton*, minced and stewed, and close packed up, with tried *Sewet* or *Butter* in earthen pots. To entertain Strangers, *Marmalade*, *Suckets, Almonds, Comfits* and such like.

Some it may be will say I would have men rather to feast than fight; But I say the want of those necessaries occasions the loss of more men than in any English Fleet hath been slain since 88. For when a man is ill, or at the point of death, I would know whether a dish of buttered Rice with a little *Cynamon, Ginger*, and *Sugar*, a little minced meet, or rost Beef, a few stew'd Prunes, a race of green *Ginger*, a *Flapjack*, a Can of fresh water brewed with a little *Cynamon*, and *Sugar*, be not better than a little *Poor John*, or *Salt Fish* with *Oil* and *Mustard*, or *Bisket, Butter, Cheese*, or *Oatmeal-pottage* on Fish-days, or on Flesh days Salt-Beef, Pork and Pease with six shillings beer, this is your ordinary Ships allowance, and good for them that are well if well conditioned which is not always, as Seamen can (too well) witness. And after a storm, when poor men are all wet, and some have not so much as a cloth to shift them, shaking with cold, few of those but will tell you, a little Sack or *Brandy* is much better to keep them in health, than a little small Beer or cold water although it be sweet. Now that every one should provide things for himself, few of them have either that providence or means, and there is neither Ale-house Tavern, nor Inn to burn a Faggot in, neither Grocer, Poulterer, Apothecary, nor Butchers Shop, and therefore the use of this Petty Tally is necessary, and thus to be employed as there is occasion. To entertain Strangers, as they are in quality every Commander should shew himself as like himself as he can, as well for the credit of the Ship, and his Setters forth as himself; but in that herein every one may moderate themselves according to their own pleasures, therefore I leave it to their own discretions, and this brief Discourse, and my self to their friendly construction, and good opinion.

CHAP.

CHAP. XV.

An Alphabetical Table *of the* Names *of all the* Parts *or* Members *of a* Ship, *and its* Appurtenances, *with the Number of the* Page *in which the* Term (*or* Word) *here form'd, is Explained at Large.*

A

Page.

AWning 26

An Anchors. Shank, Flook, Shoulder, Beam, Eye, Ring, Socket — 29

Anchor, Sheat Anchor, ſtream Anchors, 1, 2, 3

Bow Anchor 29

A loof, keep your loof 37

B

BUttocks 4

Billage 4

Beds 5

But-ends 4

Bluffe 4

Beams 5

Bend *vide* Wale 6

Bolts, *viz.* Ring, Set, Clinch, Rag, Forelock, Fend, Drive — 5

Bowe, broad-Bowe narrow-Bowe 9

Beake, Beake-head 10

Bits 10

Block, Fiſh-block 11

Bulke, Bulks head 11

Brackets 11

Bittacle 11, 12

Barnacles 13

Broming, or Breaming 13

Blocks, double-Blocks, *vide* Pullies 19

Block-ſnap 20

Brales 22

Braces 22

Bolings, Boling-bridles, the Bolins, check the Bowlings, 23

Bent 23
Bouſe 24
Bonnet 24
Boat, a Long-boat 26
Bails 26
Bail or Free 27
Boat, Trim-Boat, Wind Boat, Hold water, Forbear 27
Bight, Bitter, Bitters End 30
Breſtfaſt 30
Boye, or Boyes, Can-Boyes 31
Bonnet 31
Ballaſt, to trench Ballaſt 32
Boatſwain and his Mate 35
Bear, Bear in, Bear off, Bear up. 44
Breeze 46
Boarding 57

C

Cradle 1
Carling, Carling Knees 7
Commings 7
Capſtain, Bars 7
Jear Capſtain 8
Crab 2
Clamps 6
Culvertail 7
Combe 10
Croſpiece 10
Cat 11
Cubbridge head 11
Counter, upper and lower 11
Cabin, great Cabin 11
Compaſs, Dark Compaſs 11
Variation Compaſs 12
Cat-holes 12
Calking, Calking-Irons 13
Careene 13
Cotes 16
Cheeks 16
Cap 16
Cordage, *vide* Rigging 18
Coller 18
Crows-Feet 18
Cock 19
Chains 19
Can-hooks 21
Creengles 22
Clew 22
Caburn 24
Caskets 25
Cable, 1, 2, 3
Splice a Cable, a Shot of Cable, Quoile a Cable, Fake a Cable, Pay more Cable, Pay cheap a Cable, End for End, Bend Unbend a Cable 30
Courſe, main-Courſe, Fore-Courſe 31
Clew of a Sail 32
Coines, Canting-Coines, ſtanding Coins 33
Captain 34
Chirurgeon, and his Mate 34
Cap-Merchant 34
Carpenter and his Mate 34
Corporal 35

Cooper and his Mate 36
Coxswain and his Mate 36
Cook and his Mate 36
Cunning 37
Calm, 46
be Calmed 47
Chase, to give Chase 59

D

Dock 1
—.Wet 1
—Dry 1
Deck, half-Deck, quarter-Deck, flash Deck, cambered Deck 6
Daile 8
David 10
Dead-Mans Eye 18
Drabler 24
Drablers 31
Disimbogue 43
Drift, a Drift 43

E

Earings 23
Ease 37
Eddy wind 46
Ebbs 47
Entering 57

F

Flsh-Block 2
Fashion 2
Floor 3
Fore-Castle 9
Feather, Cut a Feather 10
Free or Bail 27
Fenders 30
Flown 39
Fly 39
Founder, Foundering 40
Floods 47

G

Garbord 3
Gallery 9
Gudgions 12
Gun, Gun-Room 12
Graveing 13
Guy 20
Garnet, Clew Garnet 22
Goaring 22
Gang 27
Gert 30
Grateings 32
Goring of a Sail 32
Gear 37
Gunner and his Mate 34
Goose-wing 41
Gust 46
Gale, a fresh Gale, a Loom-Gale 46

H

Hooks
—Foot 3
Howle 3
Hull 4
Hatches, Scuttle Hatch 7
Hanses 10

Hounds

Hounds 16
Hawſer 20
Harpings, Cat-Harpings 20
Halyares 20
Horſe 21
Head-lines 21
Hooke-loof-Hook 24
Hitch 30
Hull 40
Hullocks 41
Hold off 44
Hericano 47

I

JUnkes 30

K

KEel 2
Keelſon 3
Knees 5
Knight, fore-Knight, main-Knight 7
Knevels 7
Knettels 24
Knot, a Wall Knot, a boling-Knot, a ſheep ſhank Knot 25
Kedgers, and Kedging 29
Keckle 30

L

LImber 2
Loop, Loop-holes 7
Ladder, Entering-Ladder, Gallery-Ladder, Boltſprit-Ladder 9
Loofe 9
Lockers 12
Lannier 18
Lines, head-Lines 21
Furling Lines, Smiteing Line
Bunt Lines, Clew Limes, 22
Leech Line 23
Knave Line 24
Lee Fangs 23
Leech of a Sail 23, 32
Lifts, Top the Lifts 23
Leggs 23
Latchets 24
Laſhing 24
Lyar 36
Lieutenant 36
Larboard 37
Labour 40
Large 41
Laske 41
Line, Dipſea-line, Log-line, 43
Sounding-line 44
Land, Land to kenning, to lay a Land, Good Land fall, Bad Land fall, a head Land, a Point of Land, a Land mark, to raiſe a Land, to make a Land 43
Land locked 44
Lead 44

M

MOuld 3
Manger 10

Masted, over Masted, Taunt Masted, under-Masted, a made-Mast, or Arm-Mast, Masts steps; spend a Mast, spring a Mast 40
Martnets 23
Mats 24
Marling, Marling-spike 25
Master and his Mate 34
Marshall 35
Moar, Moar crosse, Moar alongst, Moar Proviso 45

Moonsoune 47

N

NAils, Tree-nails 4
Skupper-nails 9
No near 37
Nealed to 44

O

ORlop 5
Okum 13
Observe 42
Offing 44
Overblows 46

P

PLanks five 4
Ports 5
Paul 8
Pump, brak-Pump, Can-Pump Chain-Pump, Bar-Pump, 3
Suck Pump, Bare Pump 9
Prow 10
Paying 13
Parsling 13
Partners 16
Pillow 16
Puttocks 19
Parrels 20
Parbunkle 21
Puddings 21
Panch 24
Pilot 34
Purser 34
Port 37
Predy 37
Pike 37
Pasarado 42
Powder-Chest 57

Q

QUarters 6
Quarter-Master 35
Quoynes 64

R

RUngs 2
Rung-heads 3
Ribs 3, 20
Run 3
Rake 4
Riders 5
Ramshead 7
Rowle 12
Rudder, Rudder-Irons 12
Room, Bread-Room, Cook-Room 12

Rigging, well Rigged, over Rigged 18
Runnings 19
Ratlings 19
Ropes, Breſt-Rope, ſtanding-Rope 20
Bolt-Ropes 22
Entering Rope, Bucket-Rope, Bolt-Ropes, Port Ropes, Jear-Ropes, Preventer-Rope, Top-Rope 27
Keel-Ropes, Rudder Rope, Cat-Rope, Boy-Rope Boat-Rope, Cheſt-Rope 28
Robins 21
Reeve, and Reeveing 23
Rouſing 31
Rowling 40
Round in, Round aft 42
Reach 43
Road 44
Ride, Ride a great Road, Ride a ſtreſſe, Ride between Wind and Tide, Ride thwart Tide, Ride a Pike, Ride Croſſe 44,45
Rut of the Sea 47
Roaring of the Sea 37
Rough Sea 47

S

STocks 1
Stem 2
Stern 2, 12
Sweep 3
Skarfing, or Skarfed 3
Sleepers 3
Spurkits 3
Spindle 8
Skupper, Skupper Leathers 9
Sockets 11
Stearage 11
Shiver 19
Shrowds, Taut the Shrouds, Eaſe the Shrouds 19
Sling or Slings 21
Sheats 22
Sinnet 24
Seaſing 24
Seaſen 25
Sarve, or Service 25
Spunyarn 25
Splice, Spliceing, Room Splice, Cut Splice 25, 30
Shallop 26
Skiffe 26
Spell 27
Shearing 28
Swifting 28
Stern Faſt 30
Shank-painter 31
Stop 31
Sails; Main-Sail, Fore-Sail, Main-Top-Sail, fore-Top-Sail, Top-gallant Sail, ſtudding-Sails, Miſen and Miſen Top-Sail, Spret, and Sprit-ſail, Top-Sail, Drift-Sail, Netting-Sail 31
Head Sails, after-Sails 32
Stantions 32
Seam, Monk-Seam, Round-Seam 32

Stowage

Stowage 33
Shoot 33
Steward 35
Swabber 36
Sailers 36
Steep Tubs 37
Steering 37
Starboard 37
Steady 37
Sheat or Courſe 39
Spoon 40
Sea, a head Sea 41
Surges 44
Sew, Sewed 45
Spout 46
Storm 46
Sea, a Rough Sea, an overgrown Sea 47
Surges 47
Ship: A wholſome Ship, an unwholſome Ship, Howſing a Ship, Flaring, Crankſided, Furring, falſe Keel, Gripe, falſe Stern, the Run, a good Run, a bad Run, a Stirup, her Rake, her Loome, Heel'd, overſet, Overthrow, Walt, Wall reared, Iron ſick, Trim 52, 53, 54

T

Timber, Riſeing Timber 3
Trunnions 4
Tuck 4
Tranſome 4
Travas 12
Tiller 12
Tarpawling 16,26
Trees, Croſſe Trees, Treſſel Trees 16
Waiſt Trees, Rouſe Trees 32
Truck 17
Tackle 20
Ties 21
Tackes 22
Thoughts 26
Thowles 26
Tire of Ordnance, as the 1, 2 and 3 Tire 32
a half Tire 33
Trumpeter 35
Tally 38
Try 40
Trough 40
Tempeſt 46
Tide, Tide of Ebbe, Tide of Flood, a Windward Tide a Leeward Tide, Tide over, Tide gate, Tide, and half Tide 47
Eddy Tide 48
Top Armings 59

V

Viol 8
Vea, Vea, Vea, Vea 27
Veer, or the wind Veers
Under the Sea 40

W

Wooding 4
Wale, Chain-Wale, Gun-Wale 6
Whelps 8
Windas 8
Waſt, Waſt-boares, Waſt Trees 9
Whipſtaffe 12
War no more 37
Weather Coyle 40
Water, dead-Water, Eddy Water, 42
Foul Water 44
Water born, Water Line, Water ſhot 45
Wirlwind 46
Waſt-cloaths 59

Y

Yarns, Rope-Yarns 24
Younkers 36
Yare 37

CHAP. XVI.

Another Alphabetical Table, *Explaining all the Principal* Sea *Terms uſed in work of a Ship in all Windes and Weathers*

A

AFT or *Abaft*, fromward the Fore-part of the Ship, or toward the Stern, as *The Maſt hangs aft*, that is towards the Stern.

How chear ye fore and aft, that is, how fares all your Ships Company.

Amain, a Word uſed by a Man of War to his Enemy, and ſignifies, *Yield.*

Strike Amain, that is, Lower your Top-ſails.

The Anchor is a peek, that ſignifies the Anchor is right under the Hawſe (or hole) through which the Cable belonging to the Anchor runs out.

The Anchor is a Cock-bell, that is, hangs up and down by the Ships ſide.

The

The Anchor is foul, that is, the Cable is got about the Fluke.

An Awning, A Sail or the like, ſupported like a Canopy over the Deck, to prevent the ſcorching heat of the Sun in hot Climates.

B

To bale, to lade Water out of the Ships Hold with Buckets, or the like.

Trench the Ballaſt, divide or ſeparate it.

The Ballaſt ſhoots, that is, runs over from one ſide to the other.

To bear with the Land, &c. To ſail towards it.

To bear in, that is, to ſail before or with a Wind into a Harbour or Channel.

A Piece of Ordnance doth come to bear, that is, lies right with the Mark.

Bear up, a term uſed in conding the Ship, when they would have her ſail more before the Wind.

Bear up round, put her right before the Wind.

To Belage, to make faſt any running Rope.

To Bend a Cable, is to make it faſt.

A Birth, a conyenient ſpace to moor a Ship in.

A Bight, any part of a Rope between the ends.

The Bilge, the breadth of the place the Ship reſts on when ſhe is a ground.

The Ship is bilged, that is, has ſtruck off ſome of her Timber on a Rock or Anchor, and ſprings a Leak.

A Bittake, that whereon the Compaſs ſtands.

A Bitter, a turn of a Cable about the Bits.

The Bits, two Main-ſquare pieces of Timber, to which the Cables are faſtned when the Ship rides at Anchor.

A Bonnet, an Addition to another ſail, when they faſten it on, they ſay, *Lace on the Bonnet*; and when they take it off, *Shake of the Bonnet*; it is very rarely faſten'd to any other than the Mizon, Main, Fore-ſail, and Sprit-ſail, and thoſe Sails are called *Courſes*, as Main-courſe and Bonnet, not Main-ſail and Bonnet.

A Boom, a long Pole uſed to ſpread out the Clew of the Studding-ſail, *&c.*

Board and Board, a term uſed when two Ships come ſo near as to touch one another.

To go aboard, to go into a Ship.

To make a board, or *board it up*, is to turn to Windward.

To break Bulk, to open the Hold, and take out goods thence.

C

Careening, is bringing a Ship to lye down on one ſide while they trim and caulk the other.

Caulking, is driving of Ockham, Span-hair, and the like into all the ſeams of the Ship, to keep out Water.

To Chaſe, is to purſue another Ship, and the Ship ſo purſued is called the *Chaſe*.

To Cond or *Cun*, is to direct or guide, and *to cun a Ship* is to direct the Perſon at Helm how to ſteer her: If the Ship go *before the Wind*, then he who cuns the Ship uſes theſe terms to him at Helm, *Starboard*, *Larboard*, *Port*, *Helm a Mid-ſhips*. Starboard, is to put the Helm to the Starboard, (or right) ſide, to make the Ship go to the Larboard (or left;) for the Ship always ſails contrary to the Helm. In keeping the Ship *near the Wind*, theſe terms are uſed, *Loof*, *Keep your Loof*, *Fall not off*, *Veer no more*, *keep her to*, *touch the Wind*, *have a care of the Lee-latch*. To make her go *more large*, they ſay, *Eaſe the Helm*, *no near*, *bear up*. To keep her upon the *ſame Point*, they uſe, *Steddy*, or *as you go*, and the like. *The Ship goes Lasking*, *Quartering*, *Veering*, *or Large*; are terms of the ſame ſignification, *viz.* that ſhe neither goes by a Wind nor before the wind, but betwixt both.

The Courſe, is that Point of the Compaſs on which the Ship ſails: Alſo the Sails are called Courſes.

Cut the Sail, that is, unfurl it, and let it fall down. *A ſail is well cut*, that is, well faſhioned.

D

Dead-water, the Eddy-water at the Stern of the Ship.

To Diſembogue, is to go out of the Mouth or Strait of a Gulph.

To diſpart, is to find out the Difference of Diameters of Metals betwixt the breech and mouth of a Piece of Ordnance.

The Deck is fluſh fore and aft, that is, is laid from ſtem to ſtern without any falls or riſings.

E

End for End, a Term uſed when a Rope runs all out of the Block, ſo that it is unreeved; as when a Cable (or Hawſer) runs all out at the Hawſe, we ſay, *the Cable at the Hawſe is run out End for End.*

F

A Fathom, a Meaſure containing ſix Feet.

A Fack, is one Circle of any Rope or Cable quoil'd up round.

To farthel (or *furl*) *a Sail*, is to wrap it up cloſe together, and bind it with little ſtrings called *Caskets*, faſt to the Yard.

To fiſh a Maſt, or Yard, is to faſten a piece of Timber or Plank to the Maſt or Yard to ſtrengthen it, which Plank is called a *Fiſh*.

To lower or ſtrike the Flag, is to pull it down upon the Cap, and in Fight is a token of yielding; but otherwiſe of great reſpect.

To heave out the Flag, is to wrap it about the Staff.

Free the Boat, or *Ship*, is to bale or pump the water out.

G

The Ships Gage, is ſo many Foot as ſhe ſinks in the Water; or (to ſpeak now like a Sea-man) ſo many Foot of Water as ſhe draws.

Weather Gage, is when one Ship has the Wind (or is to weather) of another.

A loom Gale, a little Wind.

One Ship gales away from another. In fair weather when there is but little Wind that Ship which hath moſt Wind and ſails faſteſt is ſaid, to *gale* away from the other.

To greave a Ship, is to bring her to lye dry a ground, to burn off her old filth.

The Ship gripes, that is, turns her Head to the Wind more than ſhe ſhould.

H

To Hale, is the ſame as to pull

To over Hale, is when a Rope is haled too ſtiff, to hale it the contrary way, thereby to make it more ſlack.

To hail a Ship, is to call to her Company to know whither they are bound, *&c.* and is done after this manner, *Hôa the Ship!* or only *Hôa!* To which they anſwer *Hâe.* Alſo to ſalute another Ship with Trumpets or the like, is called *Hailing.*

Freſh the Hawſe, a term uſed when that part of the Cable that lies in the Hawſe is fretted or chafed, and they would have more Cable veered out, that another part of it may reſt in the Hawſe. When two Cables that come through two ſeveral Hawſes are twiſted, the untwiſting them is called *clearing the Hawſe. Thwart the Hawſe*, and *rides upon the Hawſe*, are terms uſed when a Ship lies *thwart* or croſs, or with her Stern juſt *before*, another Ships *Hawſe. Note*, That the Hawſes are the great Holes under the Head of the Ship, through which the Cables run when ſhe lies at Anchor.

The Ship heels, that is, inclines more to one ſide than the other, as *ſhe heels to Starboard*, that is, turns up her Larboard-ſide to lie down on the Starboard.

To Hitch, is to catch hold.

The Hold of a Ship, is that part betwixt the Keelſon and the lower Deck, where all Goods, Stores, and Victuals do lie. *Rummidge the Hold*, is uſed for removing or clearing the Goods and things in the Hole. *Stowing the Hold*, is when they take goods into the Hold.

To

To Hoiſe, is to hale or lift up, as *Hoiſe the water in, Hoiſe up the Yards.*

Hulling, when a Ship is at Sea, and takes in all her Sails, ſhe is ſaid to *Hull.*

L

The Ship Labours, that is, rowls and tumbles much.

Land fall, is a term uſed, when we expect to ſee Land; as we had a good *Land fall*, that is made Land (or ſaw Land,) according to our Reckoning.

Land-locked, is when the Land lies round about us, ſo that no point is open to the Sea.

Land-to, A Ship is ſaid to lie *Land-to*, when ſhe is at ſo great a diſtance as only juſt to diſcern the Land.

To Laſh, is to bind, as *Laſh the Fiſh on to the Maſt*, that is bind it to the Maſt.

Launch, is to put out, as to *Launch a Ship*, is to put her forth of the Dock into the water, but it is ſomtimes likewiſe uſed in a Negative ſenſe, as when a Yard is hoiſted high enough, they uſually call aloud *Launch-hôe*, that is hoiſe no more.

To lay the Land, is to loſe ſight of it.

The Lee-ſhore, is that ſhore againſt which the Wind blows.

Have a care of the Lee-latch, that is take heed the Ship go not too much to Lee-wards.

A Ship lies by the Lee, that is, has all her ſails lying flat againſt the Maſts and Shrouds.

M

Mizon Sail, hath ſeveral words peculiar to it, as *Set the Mizon*, that is, fit the Mizon ſail; *Change the Mizon*, that is, bring the Yard to the other ſide of the Maſt; *Speek the Mizon*, that is, put the Yard right up and down by the Maſt; *Spell the Mizon*, that is, let go the Sheet and peek it up.

To moor a Ship, is to lay out her Anchors in ſuch a manner as is moſt convenient for her to ride by ſafely.

N

N

Neap tides, are the Tides when the Moon is in the ſecond and laſt Quarter, and they are neither ſo high, nor ſo low, nor ſo ſwift as the Spring-tides.

A Ship is beneaped, a term uſed, when the water does not flow high enough to bring a ſhip from off the ground, or out of a Dock, or over a Bar.

O

The Offing, that is, fromward the ſhore, or out into the Sea; as *The Ship ſtands for the Offing,* that is, ſails from the ſhore into the Sea. When a Ship keeps the middle of the Channel, and comes not near the ſhore, ſhe is ſaid to *keep in the Offing.*

Off-ward, is contrary to the ſhore; as the ſtern of a Ship lies to the Offward, and her head to the ſhore-ward, that is, her ſtern lies toward the Sea, and her head to the ſhore.

Overſet, is turning over, but if a Ship turn over on a ſide, when ſhe is trimming a ground, it is called *overthrown.*

P

To Parcel a ſeam, is (after the Seam is caulked) to lay over it a narrow piece of Canvaſs, and pour thereon hot Pitch and Tar.

To Pay a ſeam, is to lay hot Pitch and Tar on (after Caulking) without Canvaſs.

To Ride a Peek, is when the Yards are ſo ordered, that they ſeem to make the Figure of St. *Andrews* Croſs.

To Purchaſe, in a Ship bears the ſame ſenſe as *draw* many times, as *the Capſtain purchaſes apace,* that is, draws in the Cable apace.

Q

Quarter Winds, are when the Wind comes in abaſt the main-maſt-ſhrouds even with the Quarter.

A Quoil, is a Rope or Cable laid up round one Fack over another, and the laying the Fack, is called *quoiling*.

R

A Reach, is the Diſtance between any two points of Land, that lie in a Right-line one from another.

To Reeve, is to put a Rope through a Block; and to pull a Rope out of a Block is called *unreeving the Rope*.

To Ride, When a ſhip's Anchor holds her faſt, ſo that ſhe does not drive with Wind or Tide, ſhe is ſaid to *ride at Anchor*.

To Ride athwart, is to ride with the Ships ſide to the Tide.

To Ride betwixt Wind and Tide, is when the Wind and Tide are contrary and have equal ſtrength.

To Ride Hawſe-fall, is when in a rough Sea the Water breaks into the Hawſes.

A Road, is any place near the Land where Ships may ride at Anchor, and a Ship riding there is called a *Roader*.

Rowſe-in, (that is, Hale-in) proper only to the Cable or Hawſer, and is uſed when the Cable or Hawſer is ſlack to make it taut or ſtraight.

S

A Sail. Beſides its proper ſignification (as belonging to the ſeveral Yards, from which it takes its various Names, as Main-ſail, *&c.*) it ſignifies alſo a Ship, as when at Sea we deſcry a Ship, we cry out, *A ſail*! *A ſail*! Likewiſe if we ſpeak of a Fleet (or a number of Ships together) we ſay the Fleet conſiſted of 40 or 50 ſail, and not 40 or 50 Ships.

To Serve a Rope, is to wind ſomthing about it, to keep it from fretting out.

To Seaze, is to make faſt, or bind.

The Ship ſeels, that is, when on a ſudden ſhe lies down on her ſide, and tumbles from one ſide to the other.

The Ship ſends, that is, her head or ſtern falls deep in thr trough or hollow of the Sea.

To Settle a Deck, is to lay it lower.

The Ship is ſewed, that is, the Water is gone from her.

The Ship ſhears, that is, goes in and out, and not right forward.

To Sound, is to try with a line or other thing how deep the Water is.

The Ship hath ſpent her Maſts, that is, her Maſts have been broke by foul Weather; but if a Ship loſe her Maſts in Fight, we ſay, *her Maſts were ſhot by the Board.*

To Splice Ropes, is to untwiſt two ends of Ropes, and then twiſt them both together, and faſten them with binding a ſtring about them.

The Sail is ſplit, that is, blown to pieces.

The Ship ſpooms, that is, goes right before the wind without any ſail.

Spring-tides, are the Tides at New and Full-moon, which flow higheſt and ebb loweſt, and run ſtrongeſt.

The Bow-ſprit Steeves, that is, ſtands too upright. *Steeving* is likewiſe uſed by Merchants when they ſtow Cotton or Wool, which being forced in with skrews, they call *Steeving* their Cotton or Wool.

T

Tack about, that is, bring the Ships head about to lie the other way.

Tallee aft the ſheats, a term uſed for haling aft the ſheats of the Main or Fore-ſail.

A windward Tide, when the Tide runs againſt Wind.

A Leeward Tide, when the Wind and Tide go both one way.

A Tide gate, where the Tide run ſtrong.

To Tide it up, is to go with Tide againſt the Wind, and when the Tide alters to lie at Anchor till it ſerve again.

It flows Tide and half Tide, that is, it will be High-water ſooner by three hours at the ſhore than in the *Offing.*

To Tow, is to drag any thing after the Ship.

The Traverſe, is the Ships way.

V

To Veer, is to let out; as *veer more Rope, veer more ſheat.*

W

The Ship is Walt, that is, wants ballaſt.
To Weather a Ship, is to go to Windward of her.
To Wind a Ship, is to bring her head about.
How Winds the Ship, that is, upon what point of the Compaſs does ſhe lie with her head.
To Would, is to bind Ropes about a Maſt or the like, to keep on a Fiſh to ſtrengthen it.

Y

The Ship Yaws, that is, goes in and out, and does not ſteer ſteddy.

OF

GUNNERY.

BOOK II.

Being an Abstract of the Art of *Gunnery*, (or Shooting in *Great Ordnance* and *Morter Pieces* :) Wherein the Principles of that Art are plainly Taught, both by Arithmetical Calculation, and by *Tables* ready Calculated. With the Compositions for the making of several *Fire Works*, useful in War both at *Sea* and *Land*.

CHAP. I.

Wherein is declared the Names of all sorts of Ordnance, *and their* Appurtenances, *with an Explanation of their proper* Terms ; *and divers* Observations *concerning* Shooting *in them.*

A *Cannon Royal*, a *Cannon*, a *Demi-Cannon*, a *Culvering*, *Demi Culvering*, a *Saker*, a *Minion*, and divers others : A Table of all which, with their Lengths, Weights, Charges, *&c.* you have in the Chapter following. The Names of Ordnance.

To all these belong **Carriages**, whereon Pieces do lie, supported by an Axletree betwixt two Wheels, whereon doth lie the Piece upon her **Trunnions**, which are two knobs cast with the Piece on each of her sides, which doth lie Carriages. Trunnions.

lie in two half-holes upon the two Cheeks of the Carriages,

Capsquates. to raise her up or down as you will; over them are the **Capsquares**, which are two broad Pieces of Iron, doth cover them, made fast by a Pin with a fore-lock to keep the Piece from falling out. That the Piece and Carriages is drawn a-

Wheels. long upon **Wheels** every one doth know, if she be for Land-service, they have Wheels made with Spokes like Coach-wheels, and according to their proportions strongly shod with Iron, and the Pins at the ends of the Axletree are called

Linch-pins. **Linch-pins.**

Trucks. If for Sea she have **Trucks**, which are round intire Pieces

To mount a Piece. of wood like Wheels. To **mount** a Piece is to lay her upon

To dismount a Piece. her Carriages; to **dismount** her, to take her down. Her **Bed**

Beds. is a Plank doth lie next the Piece, or the Piece upon it upon

Quoines. the Carriage, and betwixt the Piece and it they put their **Quoines**, which are great wedges of wood with a little handle at the end to put them forward or backward for levelling the

Travas: Piece as you please. To **Travas** a Piece is to turn her which

Dispart. way you will upon her Platform. To **dispart** a Piece is to find

Mouth. a difference betwixt the thickness of the metal at her **mouth**

Britch. and **britch**, or **carnouse**, which is the greatest circle about her

Carnouse. Britch, and her **muzzle ring** is the greatest circle about her

Muzzle. mouth, thereby to make a just shot, there are divers ways to dispart her, but the most easiest is as good as the best, and that is but by putting a little stick or a straw that is strait into the

Cylinder. Touch-hole to the lower part of the **Cylinder** or **Concave**,

Concave. which is the **Boze** of the Piece, and cut it off close by the me-

Bore. tal, and then apply it in the same manner to the mouth, and it will exactly shew you the difference, which being set upon

How to dispart a Piece. the muzzle of the Piece with a little Clay, Pitch, or Wax, it will be as the Pin of any Piece is to the sight, level to the Carnouse or Britch of the Piece, otherwise you may give her allowance according to your judgment.

Taper bore. **Taper bored**, is when a Piece is wider at the mouth than towards the britch, which is dangerous (if the Bullet go not

Honycomb. home) to burst her. **Honycombed**, is when she is ill cast, or over much worn, she will be rugged within, which is danger-

ous

ous for a Croſs-bar Shot to catch hold by, or any rag of he wadding being a fire, and ſticking there may fire the next Charge you put in her; and you may find it, if ſhe be Taper-bored, either with a crooked wyer at the end of a long-ſtaff, by ſcratching up and down to ſee where you can catch any hold, or a light Candle at the end of a ſtaff thruſt up and down to ſee if you can ſee any fault. **Witchings** are the Ropes by which you laſh your Ordnance faſt to the Ships-ſide in foul weather. **Chambers** is a Charge made of Braſs or Iron, which we uſe to put in at the britch of a Sling or Murtherer, containing juſt ſo much powder as will drive away the caſe of ſtones or ſhot, or any thing in her. In a great Piece we call that her Chamber, ſo far as the Powder doth reach when ſhe is loaded.

How to find it.

Britchings.

Chambers.

A **Cartrage** is a Bag of Canvaſs made upon a frame or a round piece of wood ſomewhat leſs than the Bore of the Piece, they make them alſo of Paper, they have alſo Cartrages or rather Caſes for Cartrages made of Lattin to keep the Cartrages in, which is to have no more Powder in them than juſt the Charge of your Piece, and they are cloſely covered in thoſe **Caſes of Lattin**, to keep them dry, and from any miſchances by fire, and are far more ready and ſafer than your Ladles or **Budgebarrels**. A Budgebarrel is a little Barrel made of Lattin, filled with Powder to carry from place to place for fear of fire; in the cover it hath a long neck to fill the Ladles withal without opening. A **Ladle** is a long-ſtaff with a piece of thin Copper at the end like half a Cartrage, in breadth and length ſo much as will hold no more Powder than the due Charge for the Piece it belongs to. A **Spunge** is ſuch another ſtaff, with a Piece of a Lambs skin at the end about it to thruſt up and down the Piece, to take off the duſt, moiſture, or ſparks of fire if any remain in her. And a **Rammer** is a bob of wood at the other end to ram home the Powder and the Waddings. **Waddings** is Okum, old Clouts, or Straw, put after the Powder and the Bullet. A **Caſe** is made of two Pieces of hollow wood joyned together like two half Cartrages fit to put in-

Cartrage.

Caſes.

A Budgebarrel.

A Ladle.

A Spunge.

A Rammer.

Waddings.

Wood-caſes.

to

to the Bore of a Piece, and a **Caſe-ſhot** is any kind of ſmall Bullets, Nails, old Iron, or the like to put into the Caſe to ſhoot out of the Ordnance or Murderers, theſe will do much miſchief when we lie board and board: but for Spunges and Rammers they uſe now a ſtiff Rope a little more than the length of the Piece, which you may turn and wind within board as you will, with much more eaſe and ſafety than the other.

Round-ſhot. Croſs-bar-ſhot. To arm a ſhot.

Round-ſhot is a round Bullet for any Piece: **Croſs-bar-ſhot** is alſo a Round-ſhot, but it hath a long ſpike of Iron caſt with it, as if it did go through the midſt of it, the ends whereof are commonly armed for fear of burſting the Piece, which is to bind a little **Okum** in a little Canvaſs at the end of each Pike.

Trundle-ſhot.

Trundle-ſhot is only a bolt of Iron ſixteen or eighteen Inches in length; at both ends ſharp pointed, and about a handful from each end a round broad bowl of

Langrel-ſhot.

lead according to the Bore of the Piece caſt upon it. **Langrel-ſhot** runs looſe with a Shackel, to be ſhortened when you put it into the Piece, and when it flies out it doth ſpread it ſelf, it hath at the end of either Bar a half Bullet either of

Chain-ſhot.

Lead or Iron. **Chain ſhot** is two Bullets with a Chain betwixt them, and ſome are contrived round as in a Ball, yet will ſpread in flying their full length in breadth; all theſe are uſed when you are near a Ship to ſhoot down Maſts, Yards, Shrouds, tear the Sails, ſpoil the men, or any thing

Fire-works. Arrows of Wild-fire. Pikes of Wilp fire. Granadoes of divers ſorts. Braſs-Balls.

that is above the Decks. **Fire-works** are divers, and of many Compoſitions, as **Arrows** trimmed with Wild-fire to ſtick in the Sails or Ships-ſide, ſhot burning. **Pikes** of Wild-fire to ſtrike burning into a Shipe ſide to fire her. There is alſo divers ſorts of **Granadoes**, ſome to break and fly in abundance of pieces every way, as will your **Braſs balls**, and Earthen-pots, which when they are covered with Quartered Bullets ſtuck in Pitch, and the Pots filled with good Powder, in a crowd of people will make an incredible ſlaughter; ſome will burn under water, and never extinguiſh till the ſtuff be conſumed; ſome only will burn and fume out a moſt ſtinking poyſon ſmoke; ſome, being but only an Oil, being

anoin-

anointed on any thing made of dry wood, will take fire by the heat of the Sun when the Sun ſhines hot. There is alſo a Powder, which being laid in like manner upon any thing ſubject to burn, will take fire if either any rain or water light upon it; but thoſe inventions are bad on ſhore, but much worſe at Sea, and are naught becauſe ſo dangerous, and not eaſie to be quenched, and their practice worſe, becauſe they may do as much miſchief to a friend as to an enemy, therefore I will leave them as they are.

There are alſo divers ſorts of **Powder**, the **Serpentine** is like duſt and weak, and will not keep at Sea but be moiſt. The common ſort is great corned Powder but groſs, and only uſed in great Ordnance. Your fine corned Powder for hand-Guns is in goodneſs as your Salt-peter is often refined, and from ten pence a pound to eighteen pence a Pound.

Powder. Serpentine-powder. Groſs corned. Powder. Fine corned Powder.

A **Tomkin** is a round piece of wood put into the Pieces mouth and covered with Tallow, and a **Fid**, or Fuſe, a little Okum made like a Nail put in at the Touch-hole, and covered with a thin Lead bound above it to keep the Powder dry in the Piece. **Shackels** are a kind of Rings but not round, made like them at the Hatches corners (by which we take them up and lay them down) but bigger, fixed to the midſt of the Ports within board, through which we put a Billet to keep faſt the Port from flying open in foul weather, which may eaſily indanger, if not ſink the Ship. **To cloy or poyſon a Piece**, is to drive a Nail into her Touch-hole, than you cannot give fire. And to **uncloy** her, is to put as much oyl as you can about the Nail to make it glib, and by a train give fire to her by her mouth, and ſo blow it out.

A Tomkin. A Fid. Shackels. To cloy a Piece or poyſon her. To uncloy.

Compaſs Callipers belongs to the Gunner, and is like two half Circles that hath a handle and joint like a pair of Compaſſes, but they are blunt at the points to open as you pleaſe for to diſpart a Piece. A **Horne** is his Touch-box, his **Primer** is a ſmall long piece of Iron, ſharp at the ſmall end to pierce the Cartrage through the Touch-hole. His **Lint ſtock** is a handſome carved ſtick, more than half a yard long,

Compaſs-Callipers. Horne. Priming Iron. Lint-ſtock.

Gunners Quadrant. Dark Lanthorn. Mortars. The names of ſmall Pieces. and their Implements. Bandiliers. Bullet-bags. Worms. Scowrers. Melting-Ladles. Lead-Molds. Quartered ſhot.

long, with a Cock at the one end to hold faſt his Match, and a ſharp Pike in the other to ſtick it faſt upon the Deck or Platform upright. The Gunners **Quadrant** is to level a Piece, or mount her to any random. A **dark Lanthorne** is as well to be uſed by any body as he. For **Mortars**, or ſuch Chambers as are only uſed for Triumphs, there is no uſe for them in the ſervice: but for **Curriours, Harquebuſes, Muskets, Baſtard-muskets, Colivers, Crabuts, Carbins, long Piſtols, or ſhort Piſtols,** there belong to them **Bandiliers, Bullet-bags, Worms, Scowrers, melting-Ladles, Lead, Molds** of all ſorts to caſt their ſhot. **Quarter Bullets** is but any Bullet quartered in four or eight parts, and all thoſe are as uſeful a Shipboard as on ſhore. For the Soul, Trunk, Bore, Fortification, the diverſity of their Metals, and divers other curious Theorems or terms uſed about great Ordnance, there are ſo many uncertainties as well in her Mounting, Levelling upon her Platform, as alſo the accidents that may happen in the Powder, the ground, the air, and differences in proportion, I will not undertake to preſcribe any certain Artificial Rule. Theſe proportions following are near the matter, but for your better ſatisfaction read Maſter *Digs*'s *Pantometria*, Maſter *Smith*, or Maſter *Bourn*'s Art of Gunnery, or Maſter *Robert Norton*'s Expoſition upon Maſter *Digs*'s *Stratiatico's*, *Nicholas Tartalia*, any of thoſe will ſhew the Theory at large. But to be a good Gunner you muſt learn it by practice.

CHAP. II.

How a Gunner *ought to be Qualified.*

SUppoſing him to be a Chriſtian fearing and ſerving the true God; and living in good repute and eſteem among men. He ought (beſides this) to be competently experienced in ſeveral *Arts* and *Sciences*; and eſpecially in theſe following.

1. In

1. In *Arithmetick* both *Vulgar* and *Decimal*; whereby he may be able to work the *Rule of Three* (or *Golden Rule*) both Direct and Reverse, to *Extract* the *Square* and *Cube-Roots*, *&c.*

2. In *Geometry*, whereby he may be able to take *Heights*, *Depths*, and *Distances*; To take the true *Plat* of any *Piece of Ground*; and thereby to *Mine* or *Counter-mine* under the same, or any part thereof.

3. He ought to be Experienced in making of *Ramparts*, *Cannon*, *Baskets of Earth*, and *Fire works*, both for *Service* and *Recreation.*

4. He ought to be acquainted with the *Names* of every member of which a *Piece of Ordnance* is composed, and to what use every member is appropriated.

5. He ought to know how to search and pry into the conditions of any *Gun* or *Guns* committed to his charge: As to know whether *truly bored*, or *taper* bored; whether with or without a *Chamber*; whether free from *flaws* (or *Honey-combs.*) To know what quantity of Powder will serve for a due *Charge* for each Piece, what *Shot* will fit; how many *Matrosses* to attend; how many *Horses* or *Oxen* will serve to draw any *Piece*, or (in case they cannot be had) how many *men* may serve.

CHAP. III.

Of such Necessary Implements *and* Instruments *as a* Gunner *that hath charge of* Guns *or* Artillery *ought to be furnished with.*

CArriages, Wheels, Axletrees, Ladles, Rammers, Sheepskins to make *Spunges*; *Gun Powder*, *Shot*, (*Plain* and *Cross Bar*, and also *Chain shot*), *Canvas* and *Strong Paper* to make *Cartrages*, *Fire works*, *Hand-Spikes*, to mount and dismount *Peeces*;

Peeces; a *Dark Lanthorn*, and *Budg-Barrels* to carry Powder, *Stocks*, *Match*, *Wedges*, *Tomkings*, *Priming-Irons*, &c.

Alſo he ought to be furniſhed with theſe neceſſary *Inſtruments*: (1) A *Gunner's Height-Rule* of *Wood*, or Braſs, or Braſs-circles, and a Pair or two of *Compaſſes*, one Pair with three Points to draw with *Black Lead* and *Ink*; and one plain Pair; and alſo a Pair of *Callopirs*, to take the Diameter of any Ring or Bullet. (2) A *Gunner's Quadrant* to *level*, *elevate*, or *depreſs* his *Gun*; and Engines to try the ſtrength of Powder, *&c.*

CHAP. IV.

Cautions that a Gunner ought to obſerve before he fire his Gun.

1. THAT in breaking up the Head of his *Powder-Barrels*, he uſe a *Wooden Mallet* with his Iron Tool, and not a *Hammer*, for fear of firing.

2. That he give his Gun its due *Charge* of Powder, and no more. And if by trial (before he put in his Charge) he find that his Piece is not truly *bored*, he muſt then proportion his *Charge* according to the *thineſt* ſide of the *Metal*, as ſhall be ſhewed in due place.

3. He is to conſider that a *long Wad* of Hay or untwiſted Ropes, will make the *Shot* ſhoot *wide* of the mark.

4. He ought to ſee the *Trunnions* are truly ſeated in the *Carriage*; whether one *Wheel* be higher, or reverſe faſter than the other; whether the *Platform* be *level* or not, and alſo free from *Stones* or other impediments to hinder the motion of the *Wheels*.

5. If the Gun he is to diſcharge, lie *point-blank*, or *under-Metal*, he ought to put in a ſufficient *Wad* after the *Shot*, to keep it cloſe to the *Powder*; for if the ſhot lie not cloſe, the

Peece

Peece will be ſubject to break in that vacancy. But if his Piece be mounted to any Elevation, he need not put a Wad after the ſhot.

CHAP. V.

Of Gunpowder, and how it hath been made from time to time, and how it is made at this preſent.

ANno 1380 *Gunpowder* was made of Saltpetre, Brimſtone, and Charcoal, of each a like quantity.

Anno 1410 it was made of three parts Saltpetre, and two parts of Brimſtone and Charcole.

Anno 1480 it was made of Saltpetre eight parts, and of Brimſtone and Charcoal each three parts.

Anno 1520 it was made of Saltpetre four parts, and of Brimſtone and Charcoal each one part.

Gunpowder, as it is made in this Age, is compounded of Saltpetre ſix parts, and of Brimſtone and Charcoal of each one part.

Musket-powder is now made of Saltpetre five parts, one part of Brimſtone, and one of Coal.

And Cannon powder of four times as much Saltpetre, as of Coal and Brimſtone, agreeable to that was made *Anno* 1520.

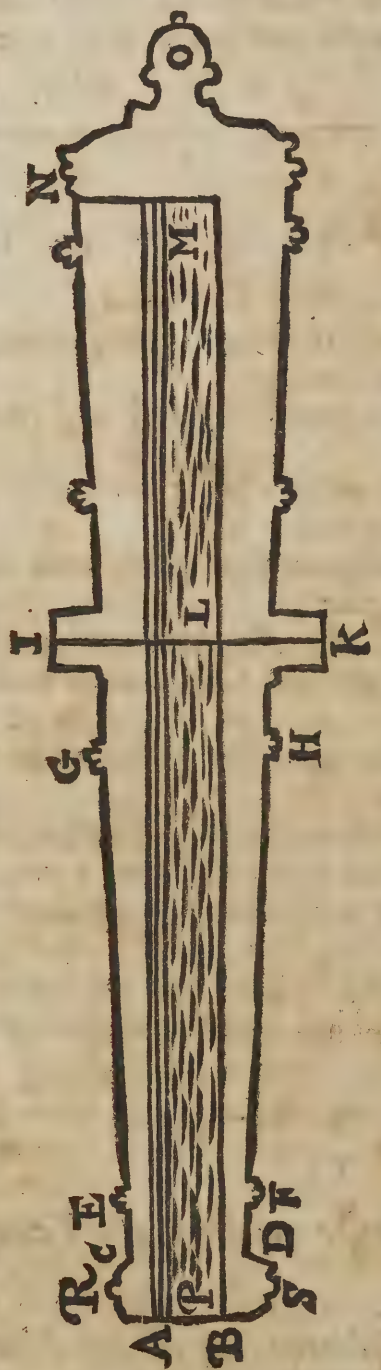
A pound of Powder as it is now made, (as it was experimented in five ſeveral ſorts of Powder here, little differing from each other, but the large corned Powder was the heavieſt) one pound will fill thirty one Cubical Inches, and ſix hundred parts of an Inch.

CHAP. VI.

Of the Names of the ſeveral parts *or* members *of a* Piece *of* Ordnance.

LEt this Figure repreſent the Ichnography of any *Great Gun* or Piece of *Ordnance*: In which,

A B



A B is the Diameter of the *Muzzle*, the *Concave Cylinder*, or *Bore* of the Piece; and the Molding above that, noted with R S is the *Muzzle* Ring, or *Cornice*.

C is the *Freeze*.

C D the Neck.

E F the *Aſtragal*, or *Cornice Ring*.

G H the *Reinforced Ring*.

I K the two *Trunnions*.

L M the *Chamber*.

N the *Baſe Ring*, and the *Touch-hole*, marked out to fall juſt with the end of the *Bore*.

O the *Caſcabel*, or *Pummel*.

P L the *Vacant Cylinder* from the *Charge* or *Chamber*, for the guide of the *Shot*.

M O the *Breech*.

M N the thickneſs of *Metal* at the *Breech*.

R is the *Diſpart*, which is a piece of a ſmall ſtick or Wyre, ſet perpendicularly upon the *Muzzle-Ring* of any *Gun*, of ſuch length that the top of it may be equal (in height) to the upper part of the *Baſe Ring*.

CHAP.

CHAP. VII.

Of the ſeveral Pieces of Ordnance *now in Uſe.*

BEfore I proceed to the practice of this Art of *Gunnery*, I ſhall give you a brief *View* of the *Names* of the ſeveral *Peeces* of *Ordnance* now in Uſe in this Nation, as alſo of four other *Pieces* uſed in *Holland*, and other parts of the *Low-Countries*; all which the following Table will expreſs at one view.

The Table Explained.

The *Table* conſiſteth of nine *Rows* or *Columes*:

In the
- *Firſt*, Is the *Names* of all *Ordinance* now in uſe.
- *Second*, Is the *Diameter* at the *Bore*, in Inches and 100 parts of an Inch.
- *Third*, Is the *Weight* of the *Peece* in Pounds.
- *Fourth*, Is the *Length* of the *Peece* in Feet, and 100 parts of a Foot.
- *Fifth*, Is the *Quantity of Powder* which will *Load* the *Piece*, in Pounds and 100 parts of a Pound.
- *Sixth*, Is the *Diameter* of the *Shot* for the *Peece*, in Inches and hundred part of an Inch.
- *Seventh*, Is the *Shot-weights*, in Pounds and hundred parts of a Pound.
- *Eight*, Is the *Length* of the *Spoon* of the *Ladle* in Inches and 100 parts.
- *Ninth*, Is the *breadth* of the *Plate* of the *Ladle*.

Firſt, And here note, That in this *Table*, the *Ladle* is but 3 *Diameters* of the *Shot* in *length*, and three fifth parts of the *Circumference*.

Secondly, The *Charge* of *Powder* from the *Cannon* to the whole

A Table wherein is described the *Names* of all sorts of *Ordnance*, from the *Cannon* to the *Base*; Also the *Lengths, Breadths, Weights, Diameters*, &c. of Powder, Shot, Ladle, *&c.* belonging to each *Peece.*

The Names of the several Peeces of Ordnance now in Use.	Diameter at the Bore	Weight	Long	The Load	Shots Diameter	Weight of Shot	Length of Ladle	Breadth of Ladle
	Inch 100 parts	pound wight	Fe 100 parts	poun 100 parts	Inch 100 parts	poun 100 parts	Inch 100 parts	Inch 100 parts
Cannon.	8.00	8000	12.00	22.50	7.50	58.00	24.00	14.75
Demi Cannon, Extra.	6.75	6000	12.00	18.00	6.62	36.00	22.75	12. 0
Demi Cannon, Ordi.	6.50	5600	10.00 11.00	17.50	6.16	32.00	22.00	12.00
Culvering, Extraordinary	5.50	4800	10.00 12.00 13.00	12.50	5.25	20.00	16.00	10.00
Culvering, Ordinary	5.25	4500	12.00	11.37	5.00	17.31	15.00	9. 50
Culvering of the least size	5.00	4000	12.00	10.00	4.75	14.90	14.25	9. 00
Demi-Culvering, Extraordinary	4.75	3000	10.00 12.00 13.00	8. 50	4.50	12.69	13.50	8. 50
Demi-Culvering Ordinary	4.50	2700	10.00	7. 25	4.25	10.26	12.75	8. 00
Demi-Culvering of the lesser size	4.25	2000	9. 00 10.00	6. 25	4.00	9. 00	12.00	8. 00
Saker, Extraordina.	4.00	1800	9. 00 10. 00	5. 00	3.75	7. 31	11.00	7. 25
Saker, Ordinary	3.75	1500	9. 00	4. 00	3.50	6. 00	10.50	6. 75
Saker of the least size	3.50	1400	8. 00	3. 37	3.25	4. 75	9. 75	6. 50
Minnion, Large	3.25	1000	8. 00	3. 25	3.00	3. 75	9. 00	5. 00
Minnion, Ordinary	3.00	750	7. 00	2. 50	2.92	3. 25	8. 50	5. 00
Faucon	2.75	750	7. 00	2. 25	2.58	2. 50	8. 25	4. 50
Fauconet	2.25	400	6. 00	1. 25	2.01	1. 31	7. 50	4. 00
Rabonet	1.50	300	5. 50	0. 75	1.28	0. 50	4. 25	2. 50
Bale	1.25	200	4. 50	0. 50	1.13	0. 50	4. 00	2. 00

whole

whole *Culvering* is allowed to be about two *Diameters* of the *Bore* of the Piece. The *Charge* from the *Culvering* to the *Minion*, two *Diameters* and a half. And from the *Minion* to the *Base*, three *Diameters*.

CHAP. VIII.

How to find the Diameter *of any* Round Shot *or* Bullet, *by knowing the* Circumference: *Or, By having the* Circumference *of a* Shot, *to find the Diameter.*

I. *Mechanically.*

GIrt the *Shot* about with a Tape, or piece of narrow Ribband; then divide the length of that Line or *Girt* into 22 equal parts, and 7 of those parts shall be the Diameter: So, if a Shot be 37 Inches about, the *Diameter* will be found to be 11 Inches 3 quarters, and somewhat more:

But if the *Diameter* were given, and the *Circumference* were required: Then divide the *Diameter* into 7 equal parts, and three times the *Diameter*, and one of the seven parts added to it, shall be equal to the *Circumference*: These ways are troublesome, wherefore another way to find the *Diameter* of any *Round Shot*, or the *Ring* of a *Gun*, is by a pair of *Calloper Compasses*, which are Compasses bowed at the Points, I need not describe them, they are known well enough; but this work may be performed by the following *Table* for finding the length of a *Dispart*, and the Diameter or Circumference of any Ring of a Gun or Shot, *&c.*

I. *The Circumference of any Ring or Bullet, given to find the* Diameter.

Find the *Circumference* of the Ring or Bullet in Inches and tenths of Inches in the *first Column* and *head* of the *Table*, and against the *Inches* in the first Column, and under the tenths

of an Inch at the head of the Table, you hand the *Diameter* in *Inches*, and 100 parts of an Inch.

Exam. Let the *Circumference* of a *Ring* or *Shot* be 23 Inches and 4 tenth parts of an Inch. Look for 23 in the first Column, and against it, under 4 in the head of the Table is 7.45 which is 7 Inches, and 45 hundred parts of an Inch, for the Diameter.

II. *The Diameter given, to find the Circumference.*

Look for the length of the *Diameter* given, among the Figures in the *Table*, and what number stands against it in the first *Column*, for they are the whole Inches in the *Circumference*; also see what Figure stands over them, at the head of the *Table*, for those are the tenths of Inches of the *Circumference*.

Example. Let the *Diameter* of a *Shot* be 7 Inches, and 7 tenths, or 70 hundreds, of an Inch. Look for this number 7.70 in the *Table*, and against it in the first Column you have 24 Inches, and 2 at the head of the *Table*; so that the *Circumference* is 24 Inches and 2 tenth parts of an Inch.

Again, if the *Diameter* given were 13 Inches 62 hundred parts of an Inch, I look in the *Table* for 13.62 and I find that 42 stands against it, in the first Column, and 8 over head; wherefore I conclude the Circumference to be 42 Inches, and 8 tenth parts of an Inch.

And this is either the *Circumference* or *Diameter* exactly and easily found by the following Table, for all *Rings* or *Shot* whose *Circumference* do not exceed 54 Inches.

III. *By Arithmetick.*

This being a thing so necessary for a Gunner to know, I will shew how it may be done Arithmetically.

The Proportion of the Diameter of any Circle, is to the Circumference thereof (according to *Archimedes*) as 7 is to 22, and that was the reason that in the former ways you divided the Circumference into 22 equal parts, and took 7 of them for the Diameter. But since *Archimedes*, other numbers have been found nearer the truth, *viz.* 113 and 355. Wherefore,

I. By

1. By the Diameter to find the Circumference:
As 113 is to 355 :: ſo is the length of any Diameter (ſuppoſe 23 Inches 31 hundred parts) to 73. 53, that is, 73 Inches, and 53 hundred parts of an Inch, for the Circumference.

The Arithmetical Work.

As 113 : to 355 :: So 23. 31 : to

	355
	11655
	11655
	6993
	8275 | 05

(73. 53

2. To find the Diameter:
2. By the Circumference to find the Diameter.
As 355 is to 113 :: So is any Circumference, (ſuppoſe 1625 Inches 25 hundred parts) to 516. 77 *ferè*.

The Arithmetical Work.

As 355 : to 113 :: So 1625.25 : to 516.77.

	113
	487575
	162525
	162525
	183653.25

(516.77 *ferè*

That is 516 Inches, and 77 hundred parts of an Inch (which is a ſmall matter above 3 quarters of an Inch) for the Diameter; and according to this Rule is the following Table Calculated.

CHAP. IX.

A TABLE shewing how to find the Diameter *of any Circle or* Ring *of a* Gun *not exceeding* 54 *Inches: Of excellent use for the easie and exact finding of the length of the* Dispart *of any Gun: As also of the* Diameter *of any* Shot *or* Bullet: *without* Callopers, *and also of* Granada-Shells.

Tenth Parts of Inches.

The Circumference of the Ring or Bullet in the Inches.	0	1	2	3	4	5	6	7	8	9
0	0. 00	0. 03	0. 06	0. 09	0. 13	0. 16	0. 19	0. 22	0. 25	0. 29
1	0. 32	0. 35	0. 38	0. 41	0. 44	0. 48	0. 51	0. 54	0. 57	0. 60
2	0. 64	0. 67	0. 70	0. 73	0. 76	0. 80	0. 83	0. 85	0. 89	0. 92
3	. 95	0. 98	0. 91	1. 05	1. 08	1. 11	1. 15	1. 18	1. 21	1. 24
4	1. 27	1. 30	1. 34	1. 37	1. 40	1. 43	1. 46	1. 50	1. 53	1. 56
5	1. 59	1. 62	1. 65	1. 68	1. 72	1. 75	1. 78	1. 81	1. 85	1. 88
6	1. 91	1. 94	1. 97	2. 00	2. 03	2. 07	2. 10	2. 13	2. 16	2. 19
7	2. 23	2. 26	2. 29	2. 32	2. 36	2. 39	2. 42	2. 45	2. 48	2. 51
8	2. 55	2. 58	2. 61	2. 64	2. 67	2. 71	2. 74	2. 77	2. 80	2. 83
9	2. 86	2. 90	2. 93	2. 96	3. 00	3. 02	3. 06	3. 09	3. 12	3. 15
10	3. 18	3. 21	3. 25	3. 28	3. 31	3. 34	3. 37	3. 41	3. 44	3. 47
11	3. 50	3. 53	3. 56	3. 60	3. 63	3. 66	3. 69	3. 72	3. 75	3. 79
12	3. 82	3. 85	3. 88	3. 91	3. 95	3. 98	4. 01	4. 04	4. 07	4. 11
13	4. 14	4. 17	4. 20	4. 23	4. 26	4. 30	4. 33	4. 36	4. 39	4. 42
14	4. 46	4. 49	4. 52	4. 55	4. 58	4. 62	4. 65	4. 68	4. 71	4. 74
15	4. 77	4. 80	4. 83	4. 87	4. 90	4. 93	4. 97	5. 00	5. 03	5. 06
16	5. 09	5. 12	5. 16	5. 19	5. 22	5. 25	5. 28	5. 31	5. 34	5. 37
17	5. 41	5. 44	5. 47	5. 51	5. 64	5. 67	5. 60	5. 63	5. 67	5. 70
18	5. 73	5. 76	5. 79	5. 82	5. 86	5. 89	5. 92	5. 95	5. 98	6. 01
19	6. 05	6. 08	6. 11	6. 14	6. 17	6. 21	6. 24	6. 27	6. 30	6. 33
20	6. 37	6. 39	6. 43	6. 46	6. 49	6. 52	6. 56	6. 59	6. 62	6. 65

Tenth

The Circumference of the Ring or Bullet in Inches.

Inches.	Tenth parts of Inches. 0	1	2	3	4	5	6	7	8	9
21	6. 68	6. 72	6. 75	6. 78	6. 81	6. 84	6. 88	6. 91	6. 94	6. 97
22	7. 00	7. 03	7. 07	7. 10	7. 13	7. 16	7. 19	7. 22	7. 26	7. 29
23	7. 37	7. 35	7. 38	7. 42	7. 45	7. 48	7. 51	7. 54	7. 58	7. 61
24	7. 64	7. 67	7. 70	7. 73	7. 77	7. 80	7. 83	7. 86	7. 89	7. 93
25	7. 96	7. 99	8. 02	8. 05	8. 08	8. 12	8. 15	8. 18	8. 21	8. 24
26	8. 28	8. 31	8. 24	8. 37	8. 40	8. 44	8. 47	8. 50	8. 53	8. 56
27	8. 59	8. 63	8. 66	8. 69	8. 72	8. 75	8. 79	8. 81	8. 85	8. 88
28	8. 91	8. 94	8. 98	9. 00	9. 04	9. 07	9. 10	9. 13	9. 17	9. 20
29	9. 23	9. 26	9. 29	9. 33	9. 36	9. 39	9. 42	9. 45	9. 49	9. 52
30	9. 55	9. 58	9. 61	9. 65	9. 68	9. 71	9. 74	9. 77	9. 80	9. 84
31	9. 87	9. 90	9. 93	9. 96	10.00	10.03	10.06	10.09	10.12	10.15
32	10.18	10.22	10.25	10.29	10.31	10.34	10.38	10.41	10.44	10.47
33	10.51	10.54	10.57	10.60	10.63	10.66	10.70	10.73	10.76	10.79
34	10.82	10.85	10.89	10.92	10.95	11.98	11.01	11.04	11.08	11.11
35	11.14	11.17	11.20	11.24	11.27	11.30	11.33	11.36	11.39	11.43
36	11.46	11.49	11.52	11.55	11.59	11.62	11.65	11.68	11.71	11.75
37	11.78	11.81	11.84	11.87	11.90	11.94	11.97	12.00	12.03	12.06
38	12.10	12.13	12.16	12.19	12.22	12.25	12.28	12.32	12.35	12.38
39	12.41	12.45	12.48	12.51	12.54	12.57	12.60	12.64	12.67	12.70
40	12.73	12.76	12.79	12.83	12.90	12.89	12.92	12.95	12.98	13.02
41	13.05	13.08	13.15	13.18	13.21	13.24	13.27	13.30	13.30	13.34
42	13.37	13.40	13.43	13.46	13.50	13.53	13.56	13.59	13.62	13.65
43	13.69	13.72	13.75	13.78	13.81	13.85	13.88	13.91	13.94	13.97
44	14.00	14.04	14.07	14.10	14.13	14.16	14.20	14.23	14.26	14.29
45	14.33	14.36	14.39	14.42	14.45	14.48	14.51	14.55	14.58	14.61
46	14.64	14.67	14.70	14.74	14.76	14.80	14.83	14.86	14.90	14.93
47	14.96	14.99	15.02	15.06	15.09	15.12	15.15	15.18	15.21	15.25
48	15.28	15.31	15.34	15.37	15.40	15.44	15.47	15.50	15.53	15.56
49	15.60	15.62	15.66	15.69	15.72	15.76	15.79	15.82	15.85	15.88
50	15.92	15.95	15.98	16.01	16.04	16.07	16.11	16.14	16.17	16.20
51	16.24	16.27	16.30	16.33	16.36	16.40	16.43	16.46	16.49	16.52
52	16.55	16.58	16.62	16.65	16.68	16.71	16.74	16.77	16.81	16.84
53	16.87	16.90	16.93	16.97	16.99	17.03	17.06	17.09	17.12	17.15

The Deſcription of the Table.

The *Table* is Calculated from one tenth part of an Inch *Circumference*, to 54 Inches *Circumference*, which is large enough for the *Girt* of the *Baſe Ring* of any *Gun*: Or for the *Circumference* of any *Bullet* or *Granado Shell*; for which purpoſes this *Table* will be ſerviceable, as ſhall be ſhewed hereafter.

The *Table conſiſting of Eleven Columns*, the firſt *Column* of the *Table* (beginning at 0 Inches, and ending at 53 Inches) ſhews the number of whole *Inches* that any *Ring* of a *Piece*, or *Girt* of a *Bullet* is in *Circumference*. The nine Figures at the Heads of the *Table*, which are 0. 1. 2. 3, *&c.* (and are larger than the reſt) ſignifie tenth parts of Inches of the *Circumference* of any *Ring* or *Bullet*. And the Figures in the other *Columns* are the *Diameters* of *Circles*, the *Girt* of whoſe *Circumference* are found in the *Side* and *Head* thereof.

The Uſe of the Table.

The Uſes of this Table are principally two, *Firſt*, by having the *Circumference* of any *Circle* given, to find the *Diameter*; or, *Secondly*, having the *Diameter*, to find the *Circumference*.

Example 1. *If the Circumference of a Circle be* 18 *Inches, and three tenth parts of an Inch, how much is the* Diameter *of that Circle?*

Find 18 Inches in the firſt Column of the Table, and three tenths at the top of the Table; and right againſt 18, and under 3, you ſhall find 5.82, that is 5 Inches, and 82 hundred parts of an Inch, for the length of the *Diameter* of that Circle.

Example 2. *If the* Diameter *of a* Circle *be* 13 *Inches and* 75 *hundred parts of an Inch, how much is the* Circumference *of that* Circle?

Look

Look for 13. 75 among the Figures in ſome of the Columns of the Table, which number you will find to ſtand under the figure 2 in the head of the Table, and againſt 43 in the firſt Column of the Table, which ſhews the *Circumference* of that *Circle* to be 43 Inches, and two tenth parts of an Inch.

CHAP. X.

Concerning the Diſparting *of any Piece of* Ordnance, *and how to find the length of the* Diſpart.

THE *Diſpart* of a Piece, is the difference between the thickneſs of the *Metal* at the *Muzzle* and *Breech* of the Piece: And to find it there are ſeveral ways.

I. *Mechanically.*

Take your *Priming Iron*, and put it down right in the *Touch-hole*, till it touch the Metal at the bottom of the *Bore*, and upon the Iron make a mark level with the top of the *Baſe Ring* of the Piece: Then apply the *Priming-Iron* to the bottom of the Metal at the *Mouth* of the Piece; and upon it make another mark, equal with the top of the *Muzzle Ring* of the Piece; ſo ſhall the diſtance between theſe two Marks, be the true length of the *Diſpart* proper for that Gun.

Another way not much differing from the former may be thus:

Take a ſmall Stick or Straw that is ſtrait, and put it into the Touch hole to the lower part of the *Cylinder* (or Concave) of the Gun, and cut it off cloſe to the Metal at the top of the *Baſe Ring* of the Piece; then apply it in the ſame manner to the *Mouth* of the Piece, and cut it off level with the top of the *Muzzle Ring*, ſo ſhall the little piece cut off be the *Diſpart*; which being ſet upright upon the top of the *Muz-*

zle

zle Ring of the Piece with Clay, Pitch or Wax, it ſhall be the true *Diſpart*.

There are other Mechanick ways to perform this Work, but the beſt of them are uncertain; wherefore I ſhall ſhew how it may be performed other ways.

II. *By the foregoing Table.*

Let the Girt *of the* Baſe Ring *of a Piece be* 42 *Inches, and the* Girt *of the* Muzzle Ring 31 *Inches; and let the length of the* Diſpart *for ſuch a Piece be required.*

Look in the firſt Column of the *Table* for 42 (the Girt of the *Baſe Ring*) and againſt it (in the next Column) is 13. 37. that is 13 Inches and 37 hundred parts of an Inch; for the *Diameter* of the *Baſe Ring*. Again, look in the firſt Column of the Table for 31. (the *Girt of the Muzzle Ring*, and againſt it (in the next Column) is 9. 87. that is, 9 Inches and 87 hundred parts of an Inch, for the *Diameter* of the *Muzzle Ring* as before; the difference between theſe is, 3. 50. which is 3 Inches and a half; the half whereof is, 1. 75 (or 1 Inch and 3 quarters) for the length of the *Diſpart* of ſuch a Gun.

Another Example:

Let the Girt *or* Circumference *of the* Baſe Ring *of a Gun be* 37 *Inches, and* 4 *tenth parts of an Inch: And let the* Girt *of the* Muzzle Ring *of the ſame Piece be* 26 *Inches and* 6 *tenths of an Inch: I would know the length of the* Diſpart *for ſuch a Gun.*

Look in the firſt Column of this Table for 37 Inches, and among the great figures at the head, for 4 (which is the 4 tenths of an Inch) And then againſt 37 in the firſt Colum, and under 4 at the top, you ſhall find 11.90, which is 11 Inches, and 90 hundred parts of an Inch (or 9 tenths of an Inch) for the *Diameter* of the *Baſe Ring* of the *Piece*: Again, look in the Table for 26 Inches in the firſt Column, and for 6 at the head of the Table, and right againſt 26 in the firſt Column, and under 6 at the head, you ſhall find this number 8.47, which is 8 Inches

Inches 47 hundred parts of an Inch: Subſtract 8. 47 from 11.90, the remainder will be 2.57, the half whereof is 1. 28, that is 1 Inch, and 28 hundred parts of an Inch, for the true length of the *Diſpart* of that Gun.

A Third Example:

	Diameter.
Girt of the *Baſe Ring*, 47 Inch. 3 tenths ——	15. 06
Girt of the *Muzzle Ring* 32 Inch. 5 tenths ——	10. 34
Their Difference	4. 72
The half 2 In. 36 hund. parts of an Inch, the *Diſpart*	2. 36

And let this ſuffice for the uſe of this Table in this place.

All theſe ways here preſcribed for *Diſparting* of a *Piece*, do ſuppoſe the *Piece* to be truly bored; but if it be *Chamber bored*, obſerve what followeth.

How to know whether a Piece *be Chamber bored, or not.*

Firſt, find the *Diſpart* of the *Piece*, by the Priming-Iron or a Stick, alſo find it by the Table; and if you find them two ways to agree, take that for the true Diſpart. Take the Diſpart by the *third way*, but if the *Diſpart* taken by the *ſeveral ways* differ, then that difference is the juſt *difference* of the *Chamber* from the true *Bore* of the *Piece*.

As for Example:

Suppoſe the *Diſpart* found by the Priming Iron to be two Inches, and by the Table 3 Inches; it ſhews that the *Chamber* differs from the true *Bore*, on each ſide one Inch; ſo that if the *Bore* of the *Piece* be *ſix* Inches high, the *Chamber* is but 4 Inches high.

This the *Gunner* ought to examine and enquire into, that he may make his *Cartridges* to load his Piece withal accordingly.

CHAP. XI.

How to know whether a Piece *of* Ordnance *be* truly bored *or not, when it is in its Carriage: and lying* Horizontally.

PRovide a *Pike-ſtaff*, which let be about one foot longer than the Bore of the Piece from the Touch-hole; and at the end thereof, faſten a Rammer head, that will juſtly fill all the Bore under the Touch-hole; and at the other end of the Staff, bore a hole big enough to put through a Rod of Iron about 16 or 18 Inches long, and at the end of the *Rod* hang a *Bullet* or *Weight* of about 7 or 8 pound; for this Weight thus diſpoſed will cauſe the ſame part of the *Rammer-head* to lye always with the ſame part uppermoſt. Put this Inſtrument thus prepared into the *Piece*, letting the *Iron Rod* and Bullet hang perpendicularly; then putting your Priming-Iron in at the Touch-hole, make a mark upon the *Rammer-head:* This done, draw your *Inſtrument* out of the *Gun*, and lay it upon a long Form or *Table*, letting the *Rod* and *Bullet* hang over the end of the *Table* as it did before out of the mouth of the Piece. Then obſerve, whether the mark you made upon the head of the Rammer when it was in the Piece, be juſt on the uppermoſt part of the ſame when it lyeth upon the *Table*; and if it be, the *Bore* of the Piece lyeth neither to the right or left hand: But if you find it to lie half or a quarter of an Inch either to the right or left hand, ſo much lyeth the *Bore* either to the right or left, and the Piece in ſhooting muſt be ordered and charged accordingly.

By what is here ſaid, may be found whether the Piece incline towards the *Right* or *Left* hand, but to know whether it lie alſo *upwards* or *downwards*, and not in the middle: Then, to

to find which way; Take the *Diameter* of the Piece at the *Touch-hole*, as is before taught: Then take a piece of *Wyre*, and bend it a little at the end that it may catch at the *Mettal* when it is drawing out at the Touch hole. This *Wyre* thus prepared, put it in at the Touch-hole, till it touch the bottom of the Metal in the Chamber, and holding it there, make a mark upon it, just even with the Touch-hole; then pull up the Wyre till it catch at the *Metal* on the top of the *Chamber*, and make another mark upon it, the distance between these two marks, is the just *Diameter* of the *Chamber*: And the distance between the first mark, and the end of the Wyre (half the Diameter of the Chamber of the Piece being substracted) will leave half the Diameter of the Piece, if the Piece be truly Bored: But if this number be more than half the Diameter of the Piece, before found, at the Touch-hole; than the Bore lyeth too far from the Touch-hole, and the upper part of the Metal is the thickest: but if lesser, then the under part of the Piece hath the most Metal.

Example: Suppose I find the Diameter of my Gun to be at the Touch-hole 12 Inches; then with my *Wyre*, I find the Diameter of the *Bore* to be 4 Inches; and to the bottom of the Metal it is 7 Inches and an half; now half the Diameter of the Bore being 2 Inches, that added to the second mark upon the Wyre, or substracted from 7 Inches and a half, the first Mark, leaves 5 Inches and a half, which is less than half the Diameter of the Gun at the Touch-hole first found, by half an Inch; and therefore the greatest part of the Metal is under the Bore of the Piece, and the Gun likeliest to break above.

And here note: If you were to make a *Dispart* for such a Gun as this, you are to make it half an Inch shorter then it will be found to be by taking the Circumference, and finding the Diameters of the Rings at the Base and Muzzle: And the like is to be observed if the difference were greater, or the upper part of the Metal had been greater.

CHAP. XII.

Concerning Guns *that are not truly* bored; *How to know what quantity of* Powder *muſt be allowed for their Loading.*

SUppoſe the Diameter of the Metal of a Piece at the Touch-hole, be 16 Inches, and the Diameter at the Bore 5 Inches and a quarter, the Weight of the Piece 4850 pound: Now ſuch a Piece will require 11 pound of Powder for its Loading: But I find the Bore to be an Inch out of its place, thence I conclude the thineſt part of the Metal is 4 Inches and half a quarter, and the thickeſt ſide 6 Inches and half a quarter, by which it appears, that one ſide is two Inches thicker than the other.

Now to find what quantity of *Powder* will be a ſufficient *Load* for ſuch a Piece, it muſt be computed from the thineſt part of the Metal, which is here 4. 375 Inches, which doubled is 8.75 Inches, to which add the Diameter at the Bore 5.25 Inches, the ſum is 14.00 Inches, which call the leſſer Diameter, and 16 the greater Diameter: And to find the quantity of Powder by Arithmetick, this is the Proportion:

As the Cube of 16 (the greater Diameter) 4096,
Is to the Cube of 14 (the leſſer Diameter) 2744;
So is 11 pound (the Powder to be allowed if the Piece had been truly Bored)
To 7.36 pound (the Powder to be allowed to the falſe Bored Piece.)

For, multiply 16 by 16, it produceth 256, and that again by 16, and it produceth 4096, which is the *Cube* of 16 the *Greater Diameter.*

Alſo, multiply 14 by 14, it produceth 196, and that again by

by 14, produceth 2744, which is the *Cube* of 14, the *Leſſer Diameter.*

Then Multiply 2744 (the *Cube* of the *Leſſer Diameter*) by 11 (the *Powder* to be allowed, if the Piece had been truly bored) the product will be 30184: which number divided by 4096 (the *Cube* of the *Greater Diameter*) gives in the Quotient 7. 36 pounds of *Powder*, which will be a ſufficient *Charge* for ſuch a falſe bored *Gun.*

CHAP. XIII.

How to diſcover what Cracks, Flaws, or Honeycombs are in any Piece of Ordnance.

AS ſoon as ever you have diſcharged any Piece of Ordnance, let one be ready to cover the Mouth of the Piece cloſe, and ſtop the Touch-hole at the ſame time; by which means you may know if any Cracks or Flaws do go through the Metal, for if any ſuch be, a viſible ſmoke will come through thoſe *Flaws* or *Cracks.*

Otherwiſe: In a clear Sun ſhine day, with a piece of *poliſhed Steel* (or plain *Looking-Glaſs*) reflect the Beams of the Sun into the hollow *Cylinder* of the Piece, ſo ſhall you have a clear ſhining light within the concave of the Piece, by which you may ſee all *Flaws, Cracks*, or *Honeycombs.*

And in caſe the Sun do not ſhine, get a Stick ſomewhat longer than the hollow of the Piece, and cut a notch at one end thereof, wherein to put a piece of a Candle; put this Stick with the Candle lighted into the Piece, by whoſe light obſerve (as well as you can) whether from one end to the other you can diſcover any *Flaws*, &c. in the Piece.

Laſtly, If upon the outſide of the Metal of any Piece of Ordnance, you ſtrike a ſmart blow with an Iron Hammer; If you then hear a hoarſe ſound, doubtleſs there are *Honeycombs*,

combs, or such like *Flaws*: But if at any stroke you hear a clear sound, you may conclude that Piece to be *sound*, and free from *Cracks*, &c.

CHAP. XIV.

Concerning the Weight *of* Iron-shot, *and* Granado-shels.

Having the Diameter *of any Cast Iron shot, you may find the Weight thereof.*

FOR, it hath been generally agreed upon, that a *Cast Iron-Bullet* of 4 Inches Diameter will weigh 9 Pound, and so make that a proportion for all other Diameters: If so, then

As the *Cube* of 4 Inches, which is 64.
Is to 9 pound weight:
So is the Cube of any other Diameter, suppose 5 Inches (*viz.* 125.)
To 17. 58 pound for the weight,
Which is 17 pound and a half and somewhat more.

Another way to perform the same somewhat easier.

This way is done by Multiplication only, and so somewhat easier than the former, and it is a way which was discovered by Mr. *Valentine Pyne*, late *Fire-Master* of *England*; and for the effecting of it, this is the *RULE*:

Cube *the* Diameter *of the* Bullet *given, then Multiply that* Cube *number by* 14, *and cut off two Figures to the right hand, the Figures to the left hand are* pounds weight, *and the other two hundred parts of a Pound.*

Example I: *Let it be required to find the Weight of a* Cast Iron Bullet, *whose Diameter is five Inches, the same as in the other Example.* The

The Cube of 5 Inches is 125, which multiplied by 14, produceth 1750, from which cut off the two figures towards the right hand, and it will be 17. 50, that is 17 pound, and 50 hundred parts of a pound, which is just 17 pound and a half; and that is the weight required.

And this way (as he found it by often experience) comes nearer to the truth than the former, of 9 Pound to 4 Inches Diameter.

Example 2. *Let the Diameter of a Shot be 6 Inches and seven Tenths of an Inch; and let the Weight thereof be required.*

Multiply 6.7 by 6.7, the Product will be 44.89 for the *Square*, and that multiplied again by 6.7 produceth 300.863 for the *Cube* of the Diameter of the Shot. Which 300.863 multiplied by 14, produceth 4212082, from which five figures to the right hand being cut off (that is three for the Decimal parts in the *Multiplicand* 300.863, and two, according as the *Rule directs*) the Remainder will be 42.12082, that is 42 Pound, and 12 hundred parts of a Pound for the Weight of the Shot whose Diameter is 6 Inches and 7 tenths of an Inch.

According to this Rule is the following *Table* made, which sheweth the weight of any *Iron Shot*, whose Diameter is given in Inches and Tenth parts of Inches; from one Inch to 20 Inches Diameter: in Pounds and 100 parts of a Pound weight.

The Use of the following Table.

EXample 1. *Let the* Diameter *of an* Iron-shot *be* 13 *Inches, what is its* weight?

Look for 13 in the first Column of the Table towards the left hand, and against it in the next Column stands 307.58, which shews that such a Shot of Iron will weigh 307 Pound, and 58 hundred parts of a Pound, which is above half a Pound.

Exam. 2. *If a Cast-*Bullet *of* Iron *be in Diameter* 11 *Inches and* 3 *Tenths of an Inch, How much doth that* Bullet *weigh?*

Look

Whole Inches in Diameter.	The Tenths of Inches.									
	0	1	2	3	4	5	6	7	8	9
1	0.14	0.19	0.27	0.31	0.38	0.47	0.57	0.69	0.82	0.96
2	1.12	1.30	1.49	1.70	1.93	1.18	2.46	2.76	3.07	3.41
3	3.78	4.17	4.59	5.27	5.50	6.00	6.53	7.09	7.68	8.39
4	8.96	9.65	10.37	11.11	11.93	12.76	13.63	14.54	15.48	16.47
5	17.50	18.58	19.69	20.84	22.05	23.30	24.59	25.93	27.32	28.75
6	30.27	31.78	32.37	35.01	36.70	38.45	40.25	42.11	44.02	45.99
7	48.02	50.11	52.26	54.46	56.73	59.07	61.46	63.92	66.45	69.03
8	71.68	74.40	77.19	80.04	82.97	85.98	89.05	92.18	95.01	98.69
9	102.06	105.50	109.01	112.61	116.39	120.03	123.90	127.78	131.77	135.84
10	140.00	144.24	148.56	152.98	157.48	162.06	166.74	171.51	176.36	181.30
11	186.34	191.47	196.69	202.51	207.43	212.92	218.52	224.22	230.02	235.92
12	241.92	248.02	254.22	260.52	266.93	273.43	280.04	286.78	293 58	201.2
13	307.58	314.73	322.00	329.37	336.86	344.46	351.80	259.99	367.93	375.99
14	384.16	392.45	400.86	409.39	418.04	426.81	436.70	444.72	453.85	463.11
15	472.50	482.01	491,56	501.42	511.32	521.34	531.50	541.78	552.20	562.36
16	573.43	584.26	595.21	606.29	617.54	628.91	640.40	652.04	663.82	67 .74
17	687.82	700.02	712.37	724.71	737.02	750.31	763.24	776.27	789.56	802.94
18	816.48	830.16	843.50	857.99	872.13	886.43	900.38	915.40	930.26	945.18
19	960.25	975.50	990.91	1000.31	1002.22	1039.00	1054.12	1075.32	1080.71	1103.33
20	1120.00	1136.19	1153.90	1170.92	1188.51	1202.41	122 .81	1241.81	1259 81	1278.12

Look for 11 Inches in the first Column of the Table, and for 3 Tenths at the top of the Table, and right against 11, and under 3, you shall find 202. 51, which is 202 Pound and an half:

	Inch.		*Pound.*
And so a *Bullet*	3. 0	The *Weight* thereof will	03. 78
being in *Dia-*	9. 6	be found to be	123. 96
meter	13. 4		336. 86
	17. 2		712. 37

Some other Uses of this Table.

THE *Table* is Calculated for 20 Inches Diameter of a Shot, or Bullet, but we have no Guns that carries a Bullet above 8 Inches, notwithstanding which, it was Calculated to 20 Inches, for finding the weight of *Granado-Shells*, which are also made of *Cast-Iron*; and the Diameter of those may from *Out* to *Out* be near 20 Inches, and therefore I shall instance in one of them.

Exam. 3. *Let there be a* Granado-Shell *whose Diameter from Out to Out, let be* 19 *Inches* 6 *Tenths; and the Diameter within* 15 *Inches and* 4 *Tenths: What is the* Weight *of that* Shell?

Look for 19 Inches in the first Column, and for 6 in the head of the Table, so against 19, and under 6 you shall find 1054. 1, Pound, which is the weight if it were a *solid Shot*; which number set down.

Then look in the first Column of the Table for 15 Inches in the first Column, and 4 in the head of the Table, and against 15 and under 4, you shall find 511. 32 Pound, which is the weight of a Shot of 15 Inches and 4 Tenths Diameter. Now if you substract 511. 32 (the weight found by the Inner Diameter) from 1054. 40 (the Weight found by the Outer Diameter) the Remainder will be 543. 08 which is 543 Pound, for the Weight of the Shell.

1054. 40	
511. 32	
543. 08	

The *Diameter* of the *Shell* without, may be found by its *Circumference*, as is before taught; or by a pair of *Calloper Compasses*:

passes: And for the *Diameter* within that may be found by putting in a Stick at the *Fuse-hole*, and measuring it by a Rule of Inches and Tenths: Or, (if the *Shell* be of equal thickness) by the thickness of the *Metal* at the *Fuse-hole*, which suppose to be 2 Inches and 1 Tenth; the double whereof is 4 Inches and 2 Tenths, and that taken from 19. 6, the Outer Diameter, leaves 15. 4 for the Inner Diameter.

19. 6	
4. 2	
15. 4	

CHAP. XV.

Concerning the following Table of Cube-Roots.

THE following Table consisteth of two Columns, in the first of which towards the left hand is contained the *Roots* of all Numbers from 1 to 100, and of their *Halves* and *Quarters*.

So in the beginning of the Table, in the first Column you have 1.0, that is, one *Inch*, one *Fathom*, one *Pound*, &c. and under 1. 0, you have 1, 2, 3, standing one under another, which is 1, 2, 3 *Quarters* of *Inches*, *Fathoms*, &c. and so on, from one Inch to 100.

In the second Column is the *Cubes* of all those Numbers which stand in the first Column: As against 2 in the first Column you shall find 8 in the second, which is the Cube of 2; for 2 multiplied by 2, produceth 4, and 4 multiplied again by 2 produceth 8, which is the *Cube* of 2. Also against 2 and 1 quarter, you shall find 11. 39 which is the *Cube* of 2 and a quarter: And thus may you find that:

	Inch.	Quar.		Cube.
The *Cube* of	4	0	is	64
	5	1		144. 90
	6	2		274. 62
	7	3		465. 48

In like manner, if the *Cube* of any Number be given, the *Root* thereof may be found: So

So if 32768 were a *Cube-number* given, and the *Root* thereof were required:

Look in the second Column of the Table (which hath the word *Cube* at the head thereof) for this Number 32768, against which you shall find (under the word *Root*) 32, which is the Root thereof, for 32 multiplied by 32 produceth 1024, and that again multiplied by 32 produceth 32768, which is the *Cube* of 32. And thus may you find that,

		Inch.	Quar.
103823		47	
30275. 25	Is the Cube of	14	2
926. 49		9	3
34. 33		3	1

The Use of the following Table of Cube-Roots, *in the solution of several* Questions, *useful in the Art of* Gunnery.

Quest. I. *If a Bullet of Iron of six Inches Diameter weigh thirty Pound, what shall a Bullet of the same Metal weigh, whose Diameter is seven Inches.*

Look in the Table for 6 in the first Column, against which you shall find 216, the *Cube* of 6: Also against 7 is 343 the *Cube* of 7. Then say by the Rule of Three:

As 216 (the *Cube* of 6 Inches.)
Is to 30 *Pound*, (the Weight of that *Bullet*):
So is 343 (the *Cube* of 7 Inches):
To 47. 64 (that is 47 Pound, and 64 hundred parts of a Pound) for the *Weight* of the *Bullet* of *Iron*, which is 7 Inches Diameter.

Multiply 343 by 30, the Product will be 10290, which divide by 216, the Quotient will be 47. 64 the *Weight* of the *Shot* required.

Quest. II. *If the Diameter of a Shot be 3 Inches and 3 Quarters, and it do weigh 7 Pound 5 Ounces, (or in Decimals 7. 31) what will the Diameter of a Shot (of the same Metal) be whose Weight is 16 Pound?*

The *Cube* of 3 Inches 3 Quarters is 52. 73. then by Proportion say,

The Table of Cubes, *and* Cube-Roots *to whole Inches, Halves and Quarters; or of any other Measure.*

Root.	Cube	Root.	Cube.	Root.	Cubes.
1 0	1.	8 0	512.	15 0	3375.
1	1. 95	1	561. 52	1	3546. 58
2	3. 37	2	614. 12	2	3723. 87
3	5. 36	3	669. 92	3	3906. 98
2 0	8	9 0	729.	16 0	4096.
1	11. 39	1	791. 45	1	4291. 02
2	15. 62	2	857. 37	2	4492. 12
3	20. 80	3	926. 86	3	4699. 42
3 0	27.	10 0	1000.	17 0	4913.
1	34. 35	1	1076. 89	1	5132. 95
2	42. 87	2	1157. 62	2	5359. 37
3	52. 73	3	1242. 30	3	5592. 36
4 0	64.	11 0	1331.	18 0	5832.
1	76. 76	1	1423. 83	1	6078. 39
2	91. 12	2	1520. 87	2	6331. 62
3	107. 17	3	1622. 23	3	6591. 80
5 0	125.	12 0	1728.	19 0	6859.
1	144. 70	1	1838. 26	1	7133. 33
2	167. 37	2	1953. 12	2	7414. 87
3	190. 11	3	2072. 67	3	7703. 73
6 0	216.	13 0	2197.	20 0	8000.
1	244. 14	1	2326. 20	1	8303. 76
2	274. 62	2	2460. 37	2	8615. 12
3	307. 55	3	2599. 60	3	8934. 17
7 0	343.	14 0	2744.	21 0	9261.
1	381. 07	1	2893. 64	1	9595. 70
2	411. 87	2	3027. 52	2	9938. 37
3	465. 48	3	3290. 46	3	10289. 11

Root.

Root.	Cube
22 0	10648.
1	11015. 14
2	11390. 62
3	11774. 52
23 0	12167.
1	12568. 08
2	12977. 87
3	13396. 48
24 0	13824.
1	14260. 51
2	14705. 12
3	15160. 92
25 0	15625.
1	16098. 45
2	16581. 37
3	17073. 86
26 0	17576.
1	18087. 89
2	18609. 62
3	19141. 30
27 0	19683.
1	20234. 83
2	20796. 87
3	21369. 23
28 0	21972.
1	21545. 26
2	23149. 12
3	23763. 67
29 0	24389.
1	25025. 20
2	25672. 37
3	26330. 61
30 0	27000.
1	27680. 64
2	28372. 62
3	29076. 05

Root.	Cube
31 0	29791.
1	30517. 58
2	31255. 87
3	32005. 98
32 0	32768.
1	33542. 01
2	34328. 12
3	35126. 42
33 0	35937.
1	36759. 95
2	37595. 37
3	38443. 36
34 0	39304.
1	40177. 39
2	41063. 63
3	41962. 80
35 0	42825.
1	43800. 33
2	44738. 87
3	45690. 73
36 0	48656.
1	47634. 76
2	48627. 12
3	49633. 17
37 0	50653.
1	51686. 70
2	52734. 37
3	53796. 11
38 0	54872.
1	55962. 14
2	57066. 62
3	58185. 55
39 0	55419.
1	60467. 08
2	61629. 88
3	62807. 48

Root	Cube
40 0	64000.
1	65207. 51
2	66430. 12
3	67667. 93
41 0	68921.
1	70189. 45
2	71473. 37
3	72772. 86
42 0	74088.
1	75418. 90
2	76765. 62
3	78128. 30
43 0	79507.
1	80901. 83
2	82881. 86
3	83740. 23
44 0	85185.
1	86644. 26
2	88121. 12
3	89614. 67
44 0	91125.
1	92652. 20
2	94196. 37
3	95757. 61
45 0	97336.
1	98931. 64
2	100544.46
3	102175.05
46 0	103823.
1	105488.58
2	107171.87
3	108872.98
47 0	110592.
1	112329.01
2	114084.12
3	115857.42

Root	Cube
49 0	117649.
	119458.95
	121287.37
	123134.35
50 0	125000.
	126884.39
	128787.62
	130709.80
51 0	132691.
	134611.33
	136590.87
	138589.73
52 0	140608.
	142645.65
	144703.12
	146780.17
53 0	148877.
	150993.70
	153130.37
	155287.11
54 0	157464.
	159661.14
	161878.62
	164116.54
55 0	167375.
	168654.08
	170953.88
	173274.48
56 0	175616.
	177978.51
	180362.12
	182766.92
57 0	185193.
	187640.45
	190109.37
	192599.85

Root	Cube
58 0	195112.
	197645.89
	200201.62
	202779.29
59 0	205379.
	208008.28
	210644.87
	213311.23
60 0	216000.
	218711.26
	221445.13
	224201.67
61 0	216981.
	229783.20
	232608.37
	235456.61
62 0	238328.
	241222.64
	244140.62
	247082.04
63 0	250047.
	253035.57
	256047.87
	259083.98
64 0	262144.
	265228.01
	268336.12
	271468.42
65 0	274625.
	277805.95
	281011.37
	284241.35
66 0	287496.
	290775.39
	294079.63
	297408.79

Root	Cube
67 0	300753.
	304142.33
	307546.87
	310976.73
68 0	314432.
	317912.76
	321419.12
	324951.17
69 0	329199.
	332092.70
	335702.37
	339338.11
70 0	343000.
	346688.14
	350402.62
	354143.54
71 0	357911.
	361705.08
	365525.87
	369373.48
72 0	373348.
	377149.51
	381078.12
	385033.92
73 0	389017.
	393027.45
	397065.37
	401130.86
74 0	405224.
	409344.89
	413493.62
	417670.30
75 0	411875.
	426107.83
	430368.87
	434658.23

Root	Cube.
76 0	438976.
	443322.26
	447697.12
	452100.67
77 0	456533.
	460994.20
	465484.37
	470003.61
78 0	474522.
	479129.64
	483736.62
	488373.04
79 0	493039.
	497734.58
	502459.87
	507214.98
80 0	512000.
	516815.01
	521660.12
	526535.95
81 0	531441.
	536376.95
	541343.37
	546340.36
82 0	550408.
	556426.39
	561515.62
	568257.97
83 0	571787.
	576969.33
	582182.87
	587427.73
84 0	592604.
	598011.76
	603351.12
	608722.17

Root	Cube.
85 0	614125.
	619559.70
	625026.17
	630525.11
86 0	636056.
	641619.14
	647214.62
	652842.54
87 0	658503.
	664196.07
	669921.87
	675680.48
88 0	681472.
	687296.51
	693154.12
	699044.92
89 0	705669.
	710926.45
	716917.37
	722941.86
90 0	729000.
	735091.89
	741217.62
	747377.29
91 0	753571.
	759798.82
	766060.87
	772357.23
92 0	778688.
	785053.26
	791453.12
	797887.67
93 0	804357.
	810861.20
	817400.37
	823974.61

Root	Cube.
94 0	830584.
	837228.64
	843908.62
	850624.04
95 0	857375.
	864161.58
	870983.87
	877841.98
96 0	884736.
	891666.01
	898632.12
	905634.42
97 0	912673.
	919747.95
	926859.37
	934007.36
98 0	941192.
	948413.39
	955671.62
	962966.79
99 0	970299.
	977668.33
	985074.87
	992518.73
100	1000000.

As 7. 31 Pound (the *weight* of the *Shot* of 3 Inch. 3 Quar.)
Is to 52.73 (the *Cube* of 3 Inch. 3 Quarters:
So is 16 Pound (the *Weight* of the *Shot* whose Diameter is fought.)
To 115, Which Number being found in the second Column of the Table (or the neareſt to it, which is 107. 17) the *Root* anſwering to this Number is 4 Inches 3 Quarters, for the *Diameter* of the *Shot*, whoſe *Weight* is 16 Pound.

Queſt. III. *If a* Saker *whoſe greateſt thickneſs is* 11 *Inches and a half, do weigh* 1900 *Pound: What will the Weight of another* Saker *be, whoſe greateſt thickneſs is eight Inches and three Quarters.*

By the *Table* I find the *Cube* of 8 Inches 3 Quarters to be 669. 92, and the *Cube* of 11 Inches and a half to be 1520.85:
Then ſay by Proportion:
As 1520. 85 (the *Cube* of the *Diameter* of the Piece whoſe *Weight* is known)
Is to 1900, (the *Weight* of the Piece:)
So is 669. 92 (the *Cube* of the *Diameter* of the Piece whoſe *Weight* you would know),
To 837 Pound almoſt.

Multiply 669. 92 (the *Cube* of 8 *Inch.* 3 *Q.*) by 1900 (the *Weight*) the Product will be 1272848. 00) which divided by 1520. 85, the *Cube* of 11 *Inch.* 3 *Qu.*) the Quotient will be 837 Pound almoſt, for the *Weight* of the Piece (or *Saker*) whoſe greateſt thickneſs is 8 *Inch.* 3 *Quar.*

This is, if the two Pieces were of the ſame *Metal*, (as both *Braſs*:) But if the Piece whoſe Weight you ſeek had been *Iron*: then having performed all the former work, as if they had been both Braſs; you muſt then work another Proportion: For, the Proportion of the *Weight* between *Braſs* and *Iron* being as 16 to 18 (as I have ſhewed in the following Chapter XVI. of this Book) *Braſs* being the heavier: Then ſay,
As 18 (the Weight of *Braſs*)
Is to 16 (the Weight of *Iron*),
So is 837 (the *Weight* of the *Piece* if it had been *Braſs*),
To 744 (the *Weight* thereof, it being of *Iron*.

Queſt.

Queſt. IV. *If a* Saker *of* 3 Inch. 3 Quar. *Diameter at the* Bore, *require* 4 *Pound of* Powder *for her* Charge, *What will a* Demi-Cannon *of* 6 Inches *and a half Diameter at the* Bore *require for her Charge?*

The *Cube* of 3 *Inch.* 3 *Qu.* is 52.73: And the *Cube* of 6 *Inch.* and a half is 274.62;

Then ſay, As 52.73 (the *Cube* of 3 *Inch.* 3 *Quart.*)

Is to 274.62 (the *Cube* of 6 *Inch.* and a half),

So is 4 Pound (the *Load* for 3 *Inches* 3 *Quarters*),

To 20.81 Pound (the *Load* for 6 *Inches* and a half.)

You are here to Note, That the Demi-Cannon ſhould be fortified ſo well as the Saker: The *Cube* of the Diameter of the Demi-Cannon is 274, of the *Saker* 52; the *Weight* of the *Saker* 1600: What ſhould the *Weight* of the Demi-Cannon be?

Say, As 52 (the *Cube* of the *Bore* of the *Saker*),

Is to 274 (the *Cube* of the *Bore* of the *Demi-Cannon*),

So 1600 (the *Weight* of the *Saker*),

To 8431 (the *Weight* that ſuch a *Demi Cannon* ſhould be of, to bear ſuch a *Charge* proportionably to the *Saker.*)

But ſuppoſe the *Demi Cannon* to be no more then 6000 Weight; then Multiply 6000 by 20.81 (the *Charge* already Calculated), the Product will be 12486000, which if you divide by 8431 (the *Weight* the *Demi-Cannon* ſhould be of) the Quotient will be 14.8, that is 14 Pound and 8 Tentlis of a Pound, which will be a ſufficient *Charge* for ſuch a Piece.

Queſt. V. *A Granado-ſhell being* 14 *Inches Diameter, and two Inches and a half ſubſtance in Metal, what is the weight of the Metal, and the content of the* Concavity *of the Shell in Cubical Inches.*

1. The Cube of 14 the Diameter of the *Shell*, is 2747; which multiplied by 11, the Product is 30184, and that divided by 21, the Quotient is $1437\frac{1}{3}$, which is the ſolid Inches in the whole, Metal and Concave both, as if it were a a ſolid Bullet of 14 Inches Diameter.

2. For the Concavity, the thickneſs of the Metal being $2\frac{1}{2}$ Inches, the double thereof is 5 Inches, which ſubſtracted

from 14 Inches, there remains 9 Inches, for the Diameter of the Concave of the Shell; then the Cube of 9 is 729; which multiplied by 11 produceth 8019; and that divided by 21, the Quotient will be 381$\frac{7}{21}$ for the ſolid Inches contained in the Concavity of the Shell: the 381 being Subſtracted from 1437, (omitting the Fractions in both Numbers) the remainder is 1056 Inches, the Cubical Inches of the Metal.

3. And becauſe one Cubical Inch of Caſt-Iron is by experience found to weigh 4 Ounces, multiply 1056 by 16, (the number of Ounces in one Pound), the Product will be 16896 Ounces, which divided by 4, the Quotient will be 4224, and that Number divided by 16, (the Number of Ounces in one Pound), the Quotient will be 264 Pounds, for the Weight of the Granado-Shell.

Queſt. VI. *By the Mould and Burthen one Ship being known, how to build another Ship of the ſame Mould, of any aſſigned Burthen, greater or leſſer.*

Suppoſe a Ship of 100 Tun, is found to be 44 foot long in the *Keel*, 20 foot broad upon the *Midſhip beam*, 9 foot deep in the *Hold*, and did *Rack* it with the *Stem forwards* 13 foot, and offward 7.

If (according to theſe Dimenſions) you would build a Ship whoſe Burthen ſhould be 200 Tun, the ſeveral Dimenſions of the Members may be found as followeth.

1. For the Keel, it being 44 foot, the Cube thereof is 85184, double this Number (becauſe the Ship you are to build is double the Burthen of the other, *viz.* 200 Tun), and it makes 170368, the Cube-Root whereof is 55, 441 foot; which is 55 foot, 4 Inches $\frac{5}{8}$ of an Inch, for the length of the *Keel*.

2. For the breadth upon the *Midſhip-beam* 20 foot; the Cube of 20 is 8000, the double whereof is 16000, whoſe Cube-Root is 25. 20 foot, that is 25 foot, 2 Inches and $\frac{1}{2}$ of an Inch, for the breadth upon the Midſhip-beam.

3. For the *depth in Hold* 9 foot, the Cube of 9 is 729, the double whereof is 1458, whoſe Cube-Root is 11.34 foot; that is 11 foot, 4 Inches for the *depth in Hold*.

4. For

4. For the *Rack forward* 13 foot; the Cube of 13 is 2197, the double whereof is 4394, whose Cube is 16.38 foot; that is 16 foot, 4 Inches and a half for the *Rack forward*.

5. For the *Rack offwards* 7 foot; the Cube of 7 is 343 the double whereof is 686, whose Cube-Root is 8. 82 foot; which is 8 foot, 9 Inches, and ¾ of an Inch, for the *Rack offwards*.

This is the natural way of working of these and the like Proportions, but when you have many Lengths to find, you may ease your self of extracting so many Cube Roots, for having found out one of them by the Cube-Root, you may find out all the rest by the Golden Rule of Proportion: Thus, having found the Length by the Keel to be 55. 44, and you would find the length of the Midship-beam proportionable to this, which in the Ship of 100 Tun was 20 foot: Say,

As 44 the length by the Keel of the Ship of 100 Tuns,
Is to 55.44 the length by the Keel of the Ship of 200 Tuns,
So is 9 foot, the depth in the Hold of the Ship of 100 Tuns,
To 11. 34, the depth in the Hold of the Ship of 200 Tuns.

And so of all the Members, as in this Synopsis,

1. For the Midship beam:
As 44 is to 55. 44, so is 20 to 25. 20:
2: For the Depth in Hold:
As 44 is to 55. 44, so is 9 to 11: 34:
3. For the Rack forward:
As 44 is to 55: 44, so is 13 to 16.38:
4. For the Rack offward:
As 44 is to 55. 44, so is 7 to 8: 82:

Or thus, having the proportion of one *Cube* to another *Cube*, you may work by that in this manner.

The Cube of		thereof is
1	Being 1. 000	
2	The Double	1. 260
3	The Triple	1: 442
4	The Quadruple	1. 557
5	The Quintuple	1. 710
6	The Sextuple	1. 817
7	The Septuple	1: 913
8	The Octuple	2. 000

And thus, by the foreſaid Suppoſition a Ship of 100 Tuns being 44 Foot by the Keel, the Length of the Keel for a Ship of 200, 300, 400 Tun, may be found by theſe Proportions:

	Tuns.				Feet.	
For a Ship of	200	Say, as 1. 000 is to 44, ſo is	1. 260	to	55. 440	the length by the Keel:
	300		1. 442		63. 448	
	400		1. 557		69. 828	
	500		1. 710		75. 240	
	600		1. 817		79. 948	
	700		1. 913		84. 172	
	800		2. 000		88. 000	

And from theſe few Proportions may be deduced many more, but theſe ſhall ſuffice to ſhew the uſe of the Cube-Root in this particular.

CHAP. XVI.

Concerning the Proportion *of the* Weights *of* Iron, Lead, Stone, *&c. And how by knowing the* Weight *of one* Shot *of* Lead, *to find the Weight of another of the like Diameter of* Iron *or* Stone.

THE Proportion between *Lead* and *Iron* is as 2 is to 3; So that a *Shot* of 3 Pounds Weight of *Lead*, will be of equal *Diameter* to one of *Iron* of two Pound *Weight*.

The Proportion between	Lead	and	Braſs	is as	24	to	19
			Stone		4		1
	Iron		Braſs		16		18
			Stone		3		8

By theſe *Proportions*, may be eaſily Calculated (in caſe *Iron-Shot* be wanting, and *Lead* or *Stone* may be had), what *Diameter* and *Weight*, *Shot* either of *Lead*, *Braſs* or *Stone* ought to be of, to fit any *Piece* of *Ordnance*: And from theſe *Proportions* the following *Table* is Calculated, for all Shots of *Lead*, *Iron*, and *Stone*, from two Inches *Diameter* to 8 Inches *Diameter*, by Inches, Halves and Quarters.

By

A Table shewing the Weight of any Shot of *Iron*, *Lead*, or *Stone*, from 2 to 8 Inches Diameter.

Inches	Quar.	*Lead*, Po.	Ou.	*Iron*, Po.	Ou.	*Stone*, Po.	Ou.
2	0	1	10½	1	1	0	7
	1	2	6	1	9	0	9
	2	3	3	2	2	0	12
	3	4	5	2	14	1	1
3	0	5	10	3	12	1	7
	1	7	2	4	12	1	13
	2	8	15	6	0	2	4
	3	11	0	7	5	2	12
4	0	13	7	8	15	3	6
	1	16	0	10	10½	4	0
	2	18	15	12	10¼	4	12
	3	22	5	14	14	5	9
5	0	26	2	17	5	6	8
	1	30	2	20	1	7	8
	2	34	11	23	2	8	11
	3	39	3	26	6	9	14
6	0	45	0	30	0	11	4
	1	51	0	34	0	12	12
	2	57	0	38	0	14	4
	3	62	0	42	0	15	12
7	0	72	0	48	0	18	0
	1	79	8	53	0	20	0
	2	87	0	58	0	22	12
	3	96	0	43	0	24	0
8	0	106	0	71	0	26	10

By this Table you may see, That if a *Gun* carry a *Shot* of 5 Inches and a half Diameter, that *Shot*, if of *Lead*, will weigh 34 Pound 11 Ounces. — If of *Iron* 23 Pound 2 Ounces: If of *Stone* but 8 Po. 11 Ounces, and so of any other, as in the Table.

Note, The *Stone* here meant is *Marble*, *Pebble*, and such like, other Stone being more soft and porous; and consequently *lighter*.

Also *Note*, That in loading your Gun for a *Stone-shot* you are not to give her the same *Charge* of Powder as for one of *Lead* or *Iron*, but abate according as the Proportions of the *Metals* are.

If you compare this *Table* with the former *Table* of *Cube Roots*, you shall find the *Cube* of each Number bear the like proportion one to another, as the *Weight* of each *Bullet* is one to another of the same *Metal*.

Example. The *Cube* of 3 and 3 Quarters is 52. 73:
The *Weight* of an Iron-Shot, which is 3 Inch. 3 Quart. is 7 Pound 5 Ounces, (or Decimally) 7. 31:

The

The *Cube* of 4 Inch. 3 Qu. is 107. 17:
The *Weight* of an Iron-Shot of that Diameter is 14 Pound 14 Ounces (or Decimally 14. 87) which is 4 Ounces more than double 7. 31, for 7. 31 doubled is 14. 62.
So likewise 52. 73 doubled is 105. 46, which does not exceed 107. 17 (the *Cube* of 3 Inch. 3 Quart.) being so doubled.

CHAP. XVII.

Concerning Gunpowder, and to find what quantity will fill any Granado Shell or Cartridge.

IT hath been often Experimented in the *Tower* of *London*, that one Pound of Powder will fill 31 *Cubical Inches*, and 600 parts, which is, a little above half one tenth part of an Inch: This being allowed, it will be no hard matter to know what quantity of *Powder* will fill any *Granado-shell*, or *Cartridge*. For the Proportion will be,

As 33. 06 *Cubical Inches*,
Is to *One Pound* of *Powder*;
So is any other Number of *Cubical Inches*,
To the Number of *Pounds* of *Powder* that will fill those *Inches*.
Whether it be *Granado shell* or *Cartridge*.

But this work being something troublesome, I shall here exhibit a *Table*, which by inspection only, will tell you what quantity of *Powder* will fill any *Granado-shell*, whose true Diameter is known, provided the *Shell* be perfectly Round.

A Table ſhewing what Quantity of Powder (in Pounds and hundred parts of a Pound) will fill any *Granado-Shell* whoſe Diameter is known :

Whole Inches in Diamter :	Tenths of Inches. 0	1	2	3	4	5	6	7	8	9
1	00.01	00.02	00.03	00.04	00.05	00.06	00.07	00.08	00.10	00.12
2	00.14	00.16	00.18	00.20	00.28	00.26	00.28	00.32	00.37	00.41
3	00.45	00.50	00.55	00.61	00.66	00.72	00.79	00.86	00.92	01.00
4	01.08	01.16	01.25	01.34	01.44	01.54	01.64	01.75	01.86	01.98
5	02.11	02.22	02.37	02.51	02.65	02.80	02.96	03.12	03.29	03.46
6	03.64	03.83	04.02	04.17	04.42	04.63	04.84	05.07	05.30	05.54
7	05.78	06.03	06.29	06.56	06.83	07.11	07.40	07.70	08.00	08.31
8	08.65	08.96	09.30	09.64	09.97	10.25	10.73	11.10	11.39	11.89
9	12.29	12.70	13.13	13.56	14.00	14.45	24.92	15.39	15.87	16.36
10	16.86	17.35	17.89	18.42	18.97	19.52	10.08	20.66	21.24	21.83
11	22.44	23.06	23.69	24.32	24.98	25.64	26.32	27.00	27.70	28.41
12	29.14	29.87	30.57	31.37	32.15	32.93	33.72	34.53	35.35	36.19
13	37.04	37.91	38.77	39.67	47.56	41.48	42.41	43.36	44.31	45.28
14	46.26	47.26	48.27	49.30	50.34	51.40	52.47	53.56	54.66	55.77
15	59.90	58.04	59.21	60.39	61.58	62.78	64.01	65.24	66.50	67.73
16	69.06	70.36	71.68	73.02	74.37	75.74	77.12	78.53	79.94	81.38

The Uſe of this Table.

Exam. 1. *If the* Diameter *of a* Granado-Shell, *be 7 Inches, how many Pounds of* Powder *will fill the ſame ?*

Look for 7 in the firſt Column of the Table towards the left hand, and right againſt it you ſhall find 5.78, which is 5 Pound, and 78 hundred parts of a Pound, which is ſomewhat above 3 Quarters of a Pound : And ſo much will fill ſuch a *Shell.*

Exam. 2. *Suppoſe the Diameter of a* Granado-Shell *to be 15 Inches and 4 Tenths of an Inch : How much* Powder *will fill that Shell?*

This

This is such a Shell as was mentioned in the Third *Example* of *Chap.* XIV.

Look for 15 Inches in the first Column of the Table towards the left hand, and for 4 Tenths of an Inch in the head of the Table; and against 15, and under 4, you shall find 61. 58, which is 61 Pounds, and 58 hundred parts of a Pound, which is somewhat above half a Pound.

CHAP. XVIII.

Concerning the Allowance of Powder *for the* Charge *of any well Fortified Gun either* Brass *or* Iron, *according to the* Weight *thereof, from one hundred to ninety hundred Weight of Metal.*

A Well *Fortified* Gun, hath her *Metal* at the *Vent* or *Touch-hole* as thick as her Diameter at the *Bore:* Now *Gunners* do allow three Ounces of Powder for every hundred Weight of Metal in *Iron Guns:* and *Four Ounces* for every hundred Weight of *Metal* in *Brass Guns:* According to this Allowance.

How much Powder must be allowed for the Charge of an Iron Gun, whose Weight is 22 *hundred.*

The Allowance for *Iron Guns* being 3 Ounces, Multiply 22 (the hundred Weights) by 3 (the allowance for Iron Guns) the Product will be 66, which divide by 16 (the Ounces in one Pound) the Quotient will be 4 and 2 remaining, which is 4 Pound and 2 Ounces; So that 4 Pound and 2 Ounces of Powder, will load such an Iron Gun.

But for a *Brass Gun* of the same Weight you must Multiply 22 by 4, and the Product will be 88, which divided by 16, the Quotient will be 5 Pound and 8 Ounces remaining, and so much must be allowed for a *Brass Gun* of 22 hundred Weight.

And according to this Rule the following *Table* was made both for *Brass* and *Iron Guns*, from one hundred weight to 90 hundred Weight.

A Table shewing what Quantity of Powder is to be allowed for the Charge of any Brass or Iron Piece of Ordnance.

C. W	*Brass.* Po. Ou	*Iron.* Po. Ou	C. W	*Brass.* Po. Ou	*Iron.* Po. Ou	C. W.	*Brass.* Po. Ou	*Iron.* Po. Ou
1	00 04	00 03	31	07 12	05 13	61	15 4	11 7
2	00 08	00 6	32	08 00	06 c	62	15 8	11 10
3	00 12	00 9	33	08 04	06 3	63	15 12	11 13
4	01 00	00 12	34	08 08	06 6	64	16 0	12 0
5	01 04	00 15	35	08 12	06 9	65	16 4	12 3
6	01 08	01 2	36	09 00	06 12	66	16 8	12 6
7	01 12	01 5	37	09 04	06 15	67	16 12	12 9
8	02 00	01 8	38	09 08	07 2	68	17 0	12 12
9	02 04	01 11	39	09 12	07 5	69	17 4	12 15
10	02 08	01 14	40	10 00	07 8	70	17 8	13 2
11	02 12	02 1	41	10 4	07 11	71	17 12	13 5
12	03 00	02 4	42	10 8	07 14	72	18 0	13 8
13	03 04	02 7	43	10 12	08 1	73	18 4	13 11
14	03 08	02 10	44	11 0	08 4	74	18 8	13 14
15	03 12	02 13	45	11 c4	08 7	75	18 12	14 1
16	04 00	03 0	46	11 8	08 10	76	19 0	14 4
17	04 04	03 3	47	11 12	08 13	77	19 4	14 7
18	04 08	03 6	48	12 0	09 c	78	19 8	14 10
19	04 12	03 9	49	12 4	09 3	79	19 12	14 13
20	05 00	03 12	50	12 8	09 6	80	20 c	15 0
21	05 04	03 15	51	12 12	09 9	81	20 4	15 3
22	05 08	04 2	52	13 0	09 12	82	20 8	15 6
23	05 12	04 5	53	13 4	09 15	83	20 12	15 9
24	06 00	04 8	54	13 8	10 2	84	21 0	15 12
25	06 04	04 11	55	13 12	10 5	85	21 4	15 15
26	06 08	04 14	56	14 0	10 8	86	21 8	16 2
27	06 12	05 1	57	14 4	10 11	87	21 12	16 5
28	07 00	05 4	58	14 8	10 14	88	22 0	16 8
29	07 04	05 7	59	14 12	11 1	89	22 4	16 11
30	07 08	05 10	60	15. 0	11 4	90	22 8	16 14

The Use of the TABLE.

If an Iron or Braſs Gun do weigh 57 hundred Weight, what Quantity of Powder muſt be allowed for her Charge.

Look for 57 in the Column of the Table that hath *C W* at the top of it, ſignifying hundred Weight; and againſt 57 (towards the right hand)you ſhall find 14 Pound 4 Ounces for to Load a Braſs Gun; and 10 Pound 11 Ounces to Load an Iron Gun of 57 hundred Weight.

CHAP. XIX.

Concerning Cartredges, *how to make them, and fit them, fitting for the* Bore, *or* Chamber *of any* Piece *of* Ordnance.

I. *How* Cartredges *are made.*

Cartredges are made of *Stiff Paper*, or *Canvaſs*, the breadth of which muſt be three Diameters of the *Bore* of the *Chamber* of the *Gun* for which it is made, and about four Diameters for the length: Theſe pieces (if *Canvaſs*) muſt be ſewed about a *Former*, which is a round piece of Wood, which muſt be a very little leſs than the Diameter of the *Bore* (or *Chamber*) of the *Gun*; unto which a Bottom of *Canvaſs* muſt alſo be ſewed: But if you make your *Cartredge* of *Paper*, then muſt you rowl the Paper about the *Former*, and paiſt the Edges together, and alſo fit a Bottom thereto.

II. *How*

II. *How to fill* Cartredges.

The Diameter *of the* Cartredge, *and the* Pounds *of* Powder *that will Load the* Piece, *being known to find the* length *of the* Cartredge *when filled.*

Let the Diameter given be 6. 3 (that is 6 Inches and 3 tenth parts of an Inch) and let the quantity of Powder be 14. 5 (that is 14 Pound and a half:) And let it be required, to find how high the *Cartredge* muſt be filled, that it may hold juſt ſo much *Powder.*——To effect this it will be requiſite to find the *Area* of the *Circle* of the *Cartredge* in Inches and *Decimal parts* of Inches: to find which this is the Proportion:

As 28, Is to 22;
So is the Square of the Diameter 39. 69 Inches,
To the Area, 31. 18 Inches.

Multiply 6. 3. the Diameter in it ſelf, and the Product will be 39. 69 Inches, which is the *Square* of the *Diameter*; this (always) Multiply by 22, and it produceth 873. 18, which divide (always) by 28; and the Quotient will be 31. 18 Inches, and ſo many Square Inches are contained in the Area of the Circle of the *Cartredge.*

Exam. *The Area thus found, the Weight of Powder for Loading* 14. 5 *Pound, and the number of Cubical Inches in one Pound of Powder,* viz. 31.06 *known: To find how high the* Cartredge *muſt be filled.*

This is the Proportion:

As the Inches in the *Area* of the Circle 31. 18,
Is to the Powder allowed for Loading; 14. 5 Pound,
So is the *Cubical Inches* in one Pound of Powder, 31. 06,
To the depth of the *Cartredge* to be filled 14. 4 Inches:

Wherefore,

Multiply 31. 06 (the Inches in one Pound of Powder) by 14. 5 Pound (the allowance for *Loading*), the Product will be 450. 370; which divided by 31. 18 (the Inches in the

Circle of the *Cartredge*) the Quotient will be 14. 44 Inches, which is 14 Inches, and 44 hundred parts of an Inch, and so high must the *Cartredge* be filled.

This is the *Arithmetical* way to perform this Work, but it may be much abreviated by help of this little Table following, which will require but one single Multiplication.

Inches in the *Diam.* of the *Cartr.* or Sh.	Tenths of Inches in the Diameter of the Cartredge or Shot.									
	0	1	2	3	4	5	6	7	8	9
	In. 1000 *parts.*	*In.* 1000 *parts.*	*In.* 1000 *parts.*	*In.* 1000 *parts.*	*In.* 1000 *parts.*	*In.* 1000 *parts.*	*In.* 1000 *parts.*	*In.* 1000 *parts.*	*In.* 1000 *parts.*	*In.* 1000 *parts.*
2	9.889	8.970	8.173	7.471	6.868	6.330	5.852	5.427	5.046	4.704
3	4.395	4.117	3.863	3.641	3.432	3.229	3.053	2.890	2.740	2.601
4	2.473	2.353	2.243	2.141	2.044	1.954	1.879	1.791	1.717	1.648
5	1.582	1.522	1.463	1.408	1.357	1.308	1.258	1.218	1.175	1.127
6	1.099	1.063	1.029	0.996	0.966	0.930	0.908	0.881	0.855	0.831
7	0.806	0.785	0.763	0.742	0.722	0.703	0.685	0.667	0.650	0.634

The Quantity of Depth of the Cartredge, that one Pound of Powder will fill.

The Use of this Table.

I. *The* Diameter *of a* Cartredge *being given to find how much of that* Cartredge *one Pound of* Powder *will fill.*

Exam. 1. *If the Diameter of a* Cartredge *(or the hollow Chamber or Cylinder of a Gun) be 5 Inches, how much thereof will one Pound of Powder fill?*

Look for 5 Inches in the first Column towards the Left hand, against which stands 1.582, which is one Inch, and 582 thousand parts of an Inch, and so much will one Pound of Powder fill of that Cartredge or Cylinder.

Exam.

Exam. 2. *If the* Diameter *of a* Cartredge, *or* Cylinder *of a* Gun *be* 4 *Inches and* 3 *Tenths, how much thereof will one Pound of Powder fill?*

Look for 4 Inches in the firſt Column, and for 3 tenths in the head of the Table, and againſt 4 and under 3, you ſhall find 2.141, that is, 2 Inches, and 141 thouſand parts of an Inch, and ſo much will one Pound of Powder fill.

II. *The* Diameter *of the* Cartredge, 6. 3 Inches, *and the quantity of* Powder *that will* Load *the* Gun, 14. 5 Pound, *being known, to find how much of the* Cartredge *muſt be filled to hold ſo much* Powder.

Look for 6 Inches in the firſt Column, and for 3 in the head of the Table; and againſt 6, and under 3, you ſhall find 0. 996, that is, no Inches, but 996 thouſand parts of an Inch; and ſo much will one Pound of Powder fill: Now if you multiply 0. 996 by 14. 5 (the quantity of Powder to Load the Gun) the Product will be 14. 44, that is 14 Inches, and 44 hundred parts of an Inch, and ſo high muſt the *Cartredge* be filled: agreeable to the former Example.

CHAP. XX.

Concerning Carriages *for Pieces of Ordnance, and how they ſhould be made.*

1. MEaſure the length of the *Cylinder* of the *Gun*; once and a half that length ſhould the *Carriage* be.

2. Meaſure the Diameter of the *Bore* of the *Piece*, four of thoſe Diameters is the depth of the Planks at the fore-end: In the middle three and a half: At the end next the Ground two and a half: And in thickneſs one Diameter.

3. The Wheels ſhould be one half the Length of the Piece in height: The *Saker* and *Minnion Wheels* muſt exceed the former by one twelfth part: The *Faucon* and *Fauconet* by one ſixth part.

CAU-

CAUTION:

If you find that the Ground is not level on which your *Carriage* ſtands, and that one *Wheel* is higher than the other: The *Trunnions* out of due place: The *Piece* not lying truly in the *Carriage*: The *Carriage* not truly made: you muſt get theſe things amended before you ſhoot. Otherwiſe never expect to make a true Shot.

CHAP. XXI.

Concerning Shooting *in* Great Ordnance, *and how to* Load *your* Gun *Artificially, either with* Powder *or* Cartredge.

WHen you come to Charge your *Piece*, ſet your *Bondge-Barrel* on the Wind-ſide thereof; and cauſing one of your *Matroſſes* to hold the ſame aſlope, thruſt your *Ladle* into the ſame, filling it full of Powder, and then ſtrick it with a Ruler: Then fixing your Thumb juſt under the *Staff* of the *Ladle*, thruſt the ſame home to the *Chamber* of the *Piece*, where the *Powder* is to lie, turning the *Ladle* ſo, as your Thumb be directly above the *Staff*, ſo will the *Powder* empty it ſelf cleanly out of the *Ladle*: Then draw out the *Ladle*, and with the *Tampion* at the other end of the Staff, thruſt home the Powder, cauſing one of your Aſſiſtants to hold his Finger or Thumb cloſe on the Touch-hole: then take a round cloſe wad of Hay, (or untwiſted *Rope*) thruſt in the ſame with the *Rammer* head which is at the end of the *Spunge* Staff, and with it give three or four good ſtrokes; this done, put in your *Bullet* with a *Wad* after it, if the Piece be not elevated; but without any Wad after it, the Gun being elevated, for then there is no fear of its rowling out.

If you Load your Gun with a *Cartredge* (which is the beſt way) put the *Cartredge* home with the Rammer, and after it a ſufficient Wad.

CHAP.

CHAP. XXII.

How to give Level *with a Piece of* Ordnance *to make a* Shot *at any mark within* Point blank.

FIrſt, ſet your *Diſpart* upright upon the *Muzzle-Ring* juſt over the Center of the Mouth of the Piece: Then go to the *Baſe Ring*, and make a mark upon the higheſt part thereof, which is juſt over the *Cylinder* (if the Piece be true Bored) and take that for your true line.

This done, go to the *Breech* of the Piece, and hold your head about two Foot there from, bringing your *Eye*, the *mark* upon the top of the *Baſe Ring*, the top of the *Diſpart*, and the *Mark* you are to ſhoot at, all into one right line: which may be done by cauſing a *Matroſs* to raiſe or fall the Gun with an *Hank-ſpike*, as you ſhall direct him; and then ſtop the Motion of the Piece with a *Coyne*; then Prime the Peece, and give Fire.

CHAP. XXIII.

Shewing how to amend a Shot, which (by ſome accident) doth carry over, under, or wide of the Mark intended.

WHEN you have made one *Shot*, which doth not anſwer your expectation, it muſt be either *Higher*, *Lower*, or *Wide* of the *Mark*, or *both*: To remedy any of which obſerve theſe following *Rules*:

Firſt, If at the *firſt Shot* you find the Piece to ſhoot directly over the Mark; Then ſo much make your *Diſpart* longer, that the top of it may be juſt ſeen from the top of the Baſe Ring to the ſtroke of the Shot; and with this new *Diſpart* level your Piece and give Fire.

Secondly,

Secondly, If the *first Shot* had ſtrook juſt under the Mark, then bring the Piece to its former poſition, and mark how much the *Diſpart* is over the ſtroke of the Shot, and cut off of it juſt ſo much as being at the Breech of the Piece, you may diſcern the *top* of it, the *Mark* on the *Baſe Ring*, and the *ſtroke* of the Shot, in a right Line; and when you have brought it to ſuch a length, level the Piece as before; Prime and give Fire.

Thirdly, If the firſt Shot had ſtrook on the *right hand* of the *Mark*; to mend it, you muſt level the Piece as before; then ſtanding at the Breech of the Piece, obſerve the ſtroke of the Shot over the *Diſpart*, and on that part of the Baſe Ring which you then look over in a right line towards the Diſpart and ſtroke of the Shot, ſet up a Pin with a little ſoft Wax: Then level your Piece to the Mark by this Pin and the Diſpart, and then doubtleſs you will make a good Shot.——For when you level by the Metal of the Baſe Ring, where the Pin is placed, and the Mark, the Piece ſtanding at that direction, look over the top of the Diſpart, from the mark in the Baſe Ring, and you ſhall find the Piece to lie ſo much to the *Left*, as the former Shot ſtrook to the *Right* of the Mark; and ſhould now in all probability hit the *Mark*.

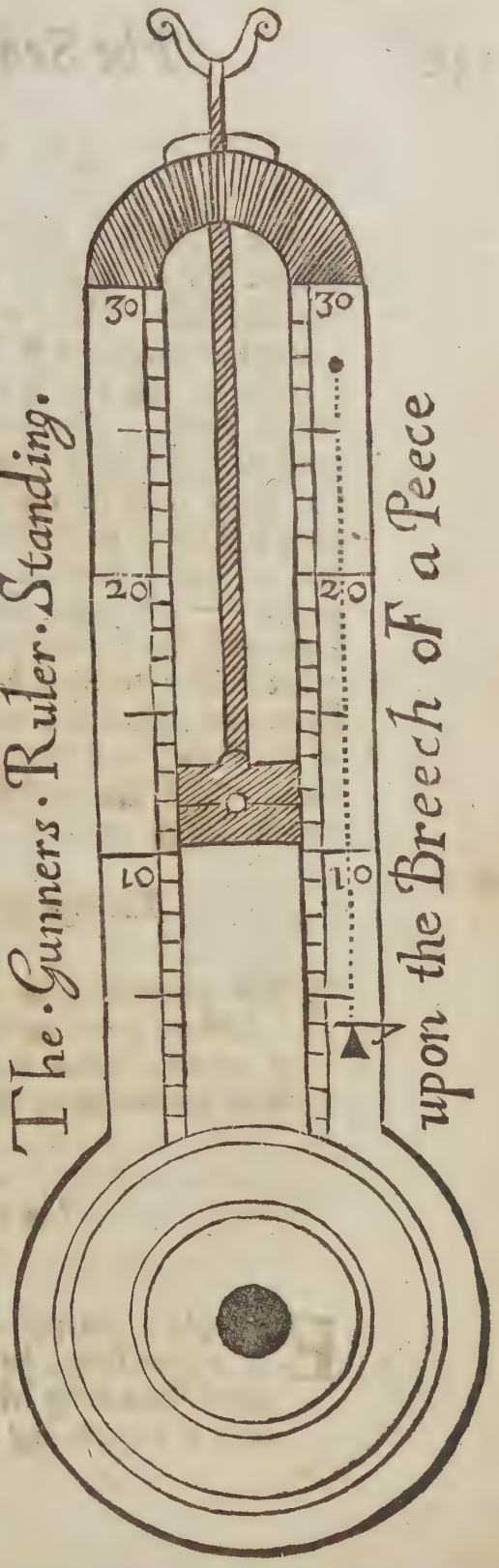
Fourthly, If the *firſt ſhot* be both *wide*, and too *high*, or too *low*; then uſe both the foregoing *Directions*:——Firſt, Regulate the *Diſpart* by making it *longer*, or cutting of it *ſhorter*, by the *Firſt* and *Second Directions* hereof, the *Shot* being *Lower* or *Higher*, and then make Uſe of this *Third Direction*, for Shooting Wide: Which things being done with care and diligence, will doubtleſs mend a bad Shot.

CHAP.

CHAP. XXIV.

Concerning a Gunner's Ruler, *for the* Elevating *of any Piece of Ordnance to any degree of* Mounture, *ſupplying the Uſe of the* Gunner's Quadrant.

FOraſmuch as a *Quadrant* cannot at all times be conveniently uſed; as when the Wind is high: Alſo in taking the depth or profundity of a Valley, or altitude of a Hill, *&c.* For the removing of all which inconveniencies this Gunner's Rule was invented, the Deſcription and Figure whereof follow:



The Gunners Ruler Standing upon the Breech of a Peece

The Description of the RULER.

The *Ruler* may be of any length, with a large *Slit* in the middle for a *Slider* to move in, and in the *Slider* a *Hole* to look through: The *Ruler* muſt be ſlit quite through at the bottom, and a piece of Braſs faſtned over it; but at the top it may be left whole for half an Inch or more; in which whole part, a *Nut* may be faſtned, through which a *Screw* muſt paſs, to *raiſe* or *depreſs* the *Slider* as occaſion requires: On both ſides of the *Slit*, the Ruler muſt be divided into Feet and tenth parts of a Foot; and every one of thoſe parts into 10 more, ſo then every Foot will be divided into 100 parts.——Through the Center of the little Hole, a ſmall Line muſt be drawn quite thro' the *Slider*, which will ſhew at what height the *Sight-hole* ſtandeth from the *Baſe Ring* of the Gun.——Alſo there muſt be an *Index* to hang on the edge of the *Ruler*, and under it a ſmall *Pin*, perpendicular to the *Pin* on which the *Index* hangeth; which is to ſet the *Ruler* perpendicular or upright.

The Uſe of the RULER.

THe principal Uſe of the *Ruler* is (as I ſaid before) to *Elevate* any Gun to any degree of *Mounture*. To perform which, there is to be uſed with the *Ruler*, this brief *Table* of *Natural Sines* following.

The uſe of the Table.

EXample 1. *Suppoſe a* Gun, *which is* 8 *Foot, and* 7 *Tenths of a Foot Long, between the* Baſe *and* Muzzle Rings, *the which* Gun *being* Mounted *and* Diſparted, *is to be* Elevated *to* 2 *Degrees and* 6 *Tenths of a Degree of* Mounture.

A Table

A Table to be used with the Gunners Rule.

Whole Degrees of Mounture.	Tenth Parts of a Degree of Mounture.									
	0	1	2	3	4	5	6	7	8	9
0	00000	00174	00349	00524	00698	00873	01047	01222	01396	01571
1	01745	01920	02094	02269	02443	02618	02792	02967	03141	03316
2	03490	03664	03839	04013	04188	04362	04536	04711	04885	05059
3	05833	05402	05582	05756	05931	06105	06279	06453	06627	06801
4	06975	07150	07324	07498	07672	07846	08020	08194	08368	08542
5	08715	08889	09063	09237	09411	09585	09758	09932	10106	10270
6	10452	10626	10780	10973	11147	11320	11494	11667	11840	12014
7	12187	12360	12533	12706	12880	13053	13226	13399	13572	13744
8	13917	14090	14263	14436	14608	14781	14954	15126	15299	15471
9	15643	15816	15988	16160	16333	16505	16677	16849	17021	17103
10	17365	17537	17708	17880	18052	18224	18395	18567	18738	18910
11	19081	19252	19423	19595	19766	19937	20108	20279	20450	20620
12	20791	20962	21132	21303	21474	21644	21814	21985	22155	22375
13	22495	22665	22835	23005	23175	23245	23514	23684	23853	24028
14	24192	24362	24531	24700	24869	25038	25207	25376	25545	25713
15	25882	26050	26219	1638-	26556	26724	26892	27060	27228	27396
16	27564	27731	27899	28067	28234	28401	28569	28736	28903	29070
17	29237	29404	29571	29737	29904	30071	30237	30403	30570	30736
18	30902	31060	31233	31399	31565	31730	31896	32061	32227	32392
19	32557	32722	32887	33051	33216	33381	33545	33710	33874	24038
20	34202	34366	34530	34694	34857	35021	35184	35375	35511	35674
21	35837	36000	36162	36325	36488	36650	36812	37002	37110	37299

Foraſmuch as the Gun is to be elevated 2 degrees and 6 Tenth parts of a degree; Look for 2 degrees in the firſt Colum of the Table, and for 6 parts of a degree in the head thereof; And againſt 2, and under 6, you ſhall find this Number, 04536, which multiply by 8. 7 (the length of the Gun in Feet and decimal parts of a Foot) the Product will be, 0394632. from which cut off (towards the right hand) five Figures for the Number taken out of the Table, and one for the 7 Tenths in length of the Gun, in all ſix Figures, then will the Product ſtand thus 0. 394632, which 0 to the left hand is no Feet, but the 3 following is 3 Tenth parts of a Foot, and the 9 following is 9 Tenths of a Tenth part of a Foot, which is neer 4 Tenth parts of a Foot, and to that Number on the ſides of the Ruler, muſt the ſtroke (and hole) in the Slider be brought, and then the Ruler is rectified for that *Elevation*

Exam: 2. *Suppoſe a* Cannon, *whoſe* Length *is* 11 *Foot and* 3 *Tenths of a Foot, were to be Mounted to* 14 *deg. and* 4 *Tenths of a degree, to what diviſions on the ſides of the Ruler muſt the* Slider *be ſet?*

Look in the firſt Columb of the Table for 14 deg. and for 3 Tenths in the head of the Table, ſo againſt 14, and under 4, you ſhall find this number 24869, which being multiplyed by 11. 3 Foot, the length of the Gun, the Product will be 2810197; from which cut of 5 Figures for the number in the Table, and 1 for the 4 Tenths in the length of the Gun, it will ſtand thus 2. 810197, which is 2 Foot, and 8 Tenth parts of a Foot, and to that number on the Sides of the Ruler, muſt the Slider be ſet, to mount the *Cannon* to 14. 4 deg. of *Elevation.*

CHAP.

CHAP. XXV.

A Table, *and the* Use *thereof, whereby you may give* Level *to a* Piece *of* Ordnance, *without the* Gunners Rule *or* Quadrant, *to any degree of* Mounture *under* 11 *degrees.*

The Length of the Gun.	Degrees of Elevation. 1	2	3	4	5	6	7	8	9	10
Five Foot	1 3	2 6	3 8	4 11	5 14	6 16	7 19	8 21	9 25	10 28
Five and a half	1 14	2 28	3 42	4 56	5 70	6 84	7 98	9 12	10 26	11 40
Six Foot	1 22	2 44	3 66	4 88	6 10	7 38	8 58	9 78	11 8	12 29
Six and a half	1 36	2 72	4 8	5 44	6 80	8 17	9 53	10 89	12 25	13 63
Seven Foot	1 47	2 94	4 41	5 88	7 35	8 82	10 30	11 77	13 24	14 73
Seven and a half	1 58	3 14	4 71	6 28	7 85	9 42	10 99	12 57	14 14	15 71
Eight Foot	1 68	3 36	5 4	6 72	8 40	10 8	11 76	13 34	15 12	16 82
Eight and a half	1 79	3 58	5 37	7 16	8 95	10 74	12 53	14 32	16 12	17 92
Nine Foot	1 89	3 79	5 68	7 58	9 47	11 37	13 27	15 18	17 8	18 98
Nine and a half	2 0	4 0	6 0	8 0	10 0	12 10	14 2	16 3	18 4	20 4
Ten Foot	2 10	4 20	6 30	8 40	10 30	12 61	14 73	16 84	18 96	21 8
Ten and a half	2 21	4 41	6 69	8 88	10 81	13 28	15 48	17 68	19 89	22 10
Eleven Foot	2 31	4 62	6 93	9 24	11 56	13 88	16 20	18 51	20 82	23 14
Eleven and a half	2 42	4 84	7 26	9 68	12 10	14 53	16 95	19 37	21 80	24 21
Twelve Foot	2 53	5 06	7 59	10 17	12 65	15 18	17 71	20 25	22 78	25 33
Twelve and a half	2 63	5 20	7 89	10 52	13 15	15 78	18 41	21 4	23 67	26 33
Thirteen Foot	2 74	5 48	8 22	10 96	13 70	16 44	19 48	21 92	24 68	27 40
Thirteen and a half	2 84	5 68	8 52	11 36	14 20	17 4	19 88	22 72	25 56	28 42
Fourteen Foot	2 95	5 90	8 85	11 80	14 75	17 70	20 65	23 60	26 56	29 53

The

The Use of this Table.

If you are deſtitute both of a *Quadrant* or a *Gunners Ruler*, yet may you *Level* a *Gun* to any degree of *Mounture* under eleven deg.

Exam. 1. *Suppoſe you have a* Gun *whoſe length is 9 Foot and half, and you would elevate it to 5 degrees of* Mounture.

Look in the Table for the length of the Gun, 9 Foot and a half, in the firſt Columb of the Table, and in that Line under 5 deg. you ſhall find 10. 0, which is juſt 10 Inches, wherefore take any ſtrait ſtick, and cut it off at that length, which ſet perpendicularly upon the top of the *Baſe Ring*, and level over the top of the *Stick*, as if it were the hole in the Slider of the *Ruler*, and the top of the diſpart upon the *Muzzle Ring*, and you will make a good Shot.

Exam. 2. *Suppoſe your Gun were 12 Foot long, and you would* Mount *her to 7 degrees of Elevation.*

Look for 12 Foot long in the firſt Columb, and for 7 deg. in the head of the Table, and againſt 12 Foot, and under 7 deg. you ſhall find 17. 71, which is 17 Inches and 71 hundred parts of an Inch (which is almoſt 3 quarters of an Inch) a *Stick* of that length ſet perpendicularly upon the *Baſe Ring*, you may level over it by the top of the Diſpart on the *Muzzle Ring*, as if it were through the hole in the *Slider*.

But if you would Level without a *Diſpart*, then take the *Diſpart* off, and lay it to the foreſaid *Stick*, cutting ſo much of it off, as was the length of the *Diſpart*; then ſet the remainder of the *Stick* upon the *Baſe Ring*, and bring the top of the *Stick*, the *Metal* of the *Muzzle Ring*, and the *Mark* in one Right line, then Prime and give Fire, and doubtleſs you will make a good Shot.

CHAP.

CHAP. XXVI.

Concerning Shooting *at* Randon.

HE that would learn perfectly to *Shoot* ot *Randon*, ought, to draw his *Piece* into a *level ground*; Where, *First*, Shooting *level*, let him obſerve the diſtance in Feet or Paces, from the Gun to the *Graze* of the *Bullet*: Then mount his *Pieee* to one degree, and mark where that doth graze, noting the diſtance as before; Then, to 2, 3, 4, *&c.* degrees, to Ten degrees, and by theſe *Elevations* and *Diſtances* make a *Table*, by which *Table*, you may, by the *Rule* of *Proportion*, find how far another *Piece* will carry her Shot from degree to degree of *Elevation*: —— But, becauſe, it is probable, that every ordinary *Gunner* cannot have leave or opportunity (the charge being great) to make ſuch *Experiment*, I ſhall here exhibit to your View, a ſhort Table of Mr. *N.N.* by him made out of a *Saker* 8 Foot long, Loaded with 3 Pound of Powder; At the firſt Shot (at one deg. of Mounture) ſhe conveyed her Shot 1125 Feet, or 225 Paces: The ſecond Shot, at 5 deg. of Mounture ſhe conveyed her Shot 2180 Feet or 416 Paces: At the third Shot, at 7 deg. of Mounture, 505 Paces: And the laſt at 10 deg. 630 Paces: In which *Experiment*, he loaded his Piece with looſe Powder exactly Weighed, alſo he weighed the Wad, and beat down the ſame with the like (or equal) ſtrength; and let the *Piece* cool half an hour between each Shot: Now by this *Table* and the *Rule of Propotion* may be found to what elevation another Gun muſt be mounted to reach any diſtance required:

Degrees of Elevation	*Randons in Paces, 5 f. to a Pace.*
1	225
2	274
3	323
4	370
5	416
6	461
7	505
8	548
9	589
10	630

Exam

Exam. *Suppose I find by my first Shot, that the Bullet grazed from my Gun 704 Paces, the Mounture of the Peece being 4 deg: How much must I Monnt her, so that she may convey her Shot 900 Paces?*

These distances of *Randons* are to be proportioned to those in the Table, by this Anology:

Saying

As 704 Paces, (the *Graze* of the Bullet at 4 deg. of Mounture,)
Is to 370 (the Paces against 4 deg. of Mounture)
So is 900, (the number of Paces to be Shot)
To 473, the Number to be found in the Table answerable to the *Degrees* of *Mounture* required.

Therefore, multiply 370 (the number against 4 deg.) by 900, (the number of Paces to be Shot,) the Product will be 333000, which divided by 704 (the *Graze* of the *Bullet* at the first Shot) and the Quotient will be 473; which number I should seek in the Table, but finding it not there, I take 461 the next less, against which stands 6 degrees, and 505 the next greater, against which stands 7 deg. the difference between these two numbers is 44, which shews the Piece must be Mounted to 6 deg. and on third part of a degree for to reach the distance of 900 Paces: For 461 is less by 12 then 473, which is neer one third part of 44 the difference.

This Table beforegoing was deduced from an experiment made by Mr. *Nat Nye* the Master Gunner of *Worcester* in *Anno* 1647. But this Table being very short, and the use of it so absolutely necessary for Gunners (especially in Land Service) I shall exhibit to their view Two other Tables tending to the same purpose, long since calculated by an able Mathematician, *viz.* Mr. *Henry Bond*, which with their *Uses* take as followeth.

The

The First Table of RANGES.

D.		D.		D.	
1	8758	31	2391	61	2832
2	7813	32	2344	62	2908
3	7077	33	2300	63	2989
4	6482	34	2260	64	3075
5	5991	35	2221	65	3168
6	5581	36	2183	66	3268
7	5234	37	2146	67	3376
8	4932	38	2111	68	3493
9	4669	39	2077	69	3621
10	4440	40	2044	70	3762
11	4237	41	2012	71	3916
12	4055	42	1981	72	4086
13	3889	43	1952	73	4276
14	3741	44	2007	74	4489
15	3606	45	2041	75	4732
16	3483	46	2076	76	5006
17	3370	47	2113	77	5303
18	3266	48	2150	78	5690
19	3279	49	2189	79	6263
20	3080	50	2230	80	6641
21	2996	51	2272	81	7274
22	2978	52	2317	82	8059
23	2845	53	2363	83	9061
24	2776	54	2412	84	10430
25	2712	55	2463	85	12330
26	2651	56	2516	86	15140
27	2593	57	2572	87	19850
28	2538	58	2633	88	25250
29	2486	59	2695	89	37480
30	2437	60	2762	90	00000

The Second Table of RANGES.

D.		D.		D.	
1	1.142	31	4.186	61	3.532
2	1.280	32	4.267	62	3.440
3	1.413	33	4.347	63	3.347
4	1.543	34	4.426	64	3.253
5	1.669	35	4.505	65	3.158
6	1.792	36	4.584	66	3.062
7	1.911	37	4.662	67	2.963
8	2.028	38	4.740	68	2.864
9	2.142	39	4.818	69	2.762
10	2.253	40	4.895	70	2.659
11	2.361	41	4.972	71	2.554
12	2.467	42	5.050	72	2.448
13	2.572	43	5.127	73	2.339
14	2.674	44	4.985	74	2.228
15	2.774	45	4.902	75	2.114
16	2.872	46	4.819	76	1.998
17	2.968	47	4.736	77	1.880
18	3.063	48	4.653	78	1.758
19	3.156	49	4.570	79	1.634
20	3.248	50	4.487	80	1.506
21	3.339	51	4.403	81	1.375
22	3.428	52	4.318	82	1.241
23	3.516	53	4.234	83	1.102
24	3.603	54	4.148	84	0.960
25	3.689	55	3.062	85	0.812
26	3.774	56	3.976	86	0.661
27	3.858	57	3.889	87	0.504
28	3.941	58	3.800	88	0.342
29	4.024	59	3.712	89	0.174
30	4.105	60	3.622	90	0.000

The Vſe of the Two Tables.

Queſtion 1. *If a Gun does carry a* Shot, *at* 13 *deg. of* Mounture 763 *Paces: What is the* Horizontal Rainge *of that* Gun?

Look in the firſt Columb of the firſt Table, for 13 the degrees of *Mounture*, againſt which you ſhall find 3889, Multiply this number by 763, the Paces that the Gun carried at 13 *deg.* of *Mounture*, the Product will be 2967307, from which cut off four Figures towards the right hand and it will be 296. 7307: So that the Gun will carry at the *Horizontal Rainge* 296 Paces, and 7 Tenths of a Pace.

Alſo, If a Piece carries her Shot, at 16 deg. of *Mounture* 1074 Paces, the *Horizontal Rainge* of that Peece will be found to be 374 Paces.

Queſtion 2. *If a* Gun *carries a Shot* 296 *Paces and* 7 *Tenths of a Pace at the* Horizontal Rainge, *how many Paces will ſhe carry at* 13 *deg. of* Mounture.

Look in the firſt Columb of the Second Table for 13 (the degrees of Mounture) againſt which ſtands 2.572, this number multiplyed by 296.7 (the *Horizontal Rainge* of the Piece) the Product will be 7631124, from which cut off 4 Figures, and it will be 763. 1124, that is 763 Paces, and ſo far will that *Gun* carry its Shot at 13 deg. of *Mounture*, which is anſwerable, and proves the foregoing *Queſtion*.

In like manner you may find, That if a Gun at its *Horizontal Rainge* carry her Shot 374 Paces, at 16 deg. of *Mounture* it will convey her Shot 174 Paces.

Queſtion 3. *If a Piece carry her Shot* 543 *Paces at* 11 *degrees of* Mounture, *how far will ſhe convey her Shot at* 19 *deg. of* Mounture?

Multiply the number ſtanding againſt 11 in the firſt Table, which

which is 4237, by 543 (the *Rainge* at 11 deg. of *Mounture*) the product will be 2300691. Then multiply this product by 3:156 (the number ſtanding againſt 19 in the ſecond Table) and this ſecond product will be 726.0980796, from, which ſeven figures being cut off towards the right hand, the remainder will be 726, and ſo many Paces will ſhe *Rainge* at 19 deg. of *Mounture.*

And thus, If a Peece at 6 deg: of *Mounture* convey her Bullet 132 Paces, you ſhall find that at 12 deg. of *Mounture* ſhe will convey it 181: 75 Paces:

CHAP. XXVII.

How you may make a good Shot *at your* Enemies Light *in a dark night.*

TO perform this, diſpart your Piece, with a piece of lighted Match, then bring your Gun, ſo that you may ſee the top of the Metal at the Breech of the Piece, the coal of the Match, and the Light you are to Shoot at, all in one Right Line; Which done, give Fire.

CHAP. XXVIII.

How to make a perfect Shot *in a dark night, at any mark (within the reach of the* Piece) *that you can ſee in the day time.*

MOunt your Piece to the Mark in the day time (as is before directed) and ſet down at what degree of *Mounture* it is elevated, then cut a ſtrait ſtick which ſhall reach from the middle of the Mouth of the Piece, perpendicularly down to the Platform, where make a Mark: Alſo, cut another ſtick which ſhall reach from the middle of the Breech of

the Piece to the Platform, and there make another Mark, through which two Marks draw a right Line, extending it 4 or 5 Foot beyond the Marks, which call, *The Line of direction.* Then in the night Season, Load your Gun with such quantity of Powder and Weight of Shot, as you know your Gun will carry to the Mark, then bring your Gun just over the Line of Direction, and by help of your two Sticks, you may bring it to the like elevation it was in the day time. All this being done, Prime and give Fire.

CHAP. XXIX.

How to make a good Shot at a Company *of* Souldiers *passing by; or at a* Ship *sailing up a* River.

THe Gun being Charged with its due quantity of Powder and Shot, and upon a Level *Rainge,* right against some Mark (as a bush Tree, *&c.*) between which, and the Gun, the Souldiers are to March, then when the Souldiers begin to hinder your Sight from the March you before observed, give Fire; and doubtless you will do good Execution.

Also, to level at a Ship Sailing up a River, the Gunner must elevate his Piece by some Cloud (if he have not some eminent Mark on the other Side of the River) and when the fore part of the Ship shall come to be against the Mark, immediately give Fire.

CHAP. XXX.

Some Reasons, *Why one and the same* Piece *of* Ordnance *at the same* Elevation, *charged with the same quantity of* Powder, *and directed to the self same Mark, and discharged several times, shall have different* Rainges.

FOr farther satisfaction in this particular. I must refer my Reader (as I said at the beginning hereof) to such Authors

thors

thors as have particularly discourſed of the Philoſophical reaſons hereof; As to Mr. *Digs* in his *Pantometria* and *Stratiaticos*; Mr. *Smith*, Mr. *Bourne*, Mr. *Norton*, *Nicholaus Tortalia*, and of late experimented by a painful man, in finding out the reaſons of theſe *Experiments*, my loving Friend Mr. *Robert Anderſon*; But ſhall here inſert an *Experiment* made by Mr. *Nat Nye* ſometime Mr. Gunner of the City of *Worceſter*, which take as followeth, *viz.* I have (ſaith he) diſcharged a Piece ſeven times in the ſpace of 50 minutes with the like Weight of Powder, Shot, and Elevation, and have found their *Rainges* as followeth, *viz.*

The	First	Shot was Conveyed	416	Paces.
	Second		436	
	Third		440	
	Fourth		432	
	Fifth		425	
	Sixth		410	
	Seventh		394	

So that the greateſt difference from the firſt Shot was about 24 Paces.

The Reaſon of theſe things is this. At the Firſt Shot, the Bullet found the Aire quiet. — And at the Second Shot, it did not only find the Aire ſtirred with the firſt Shot, but alſo tending towards the place at which it Shot, and becauſe it is more eaſie to move and penetrate that which is already moved and open, then that which is cloſe and quiet, it followeth that the Second Shot, finding in its Rainge a leſſer reſiſtance then the firſt did, it did out Shoot the firſt.

A Second Reaſon is, At the firſt Shot the Powder being put into the Piece, doth oftentimes find the ſame ſomewhat moiſt, by which means the Powder will not fire quickly; as when the Piece is dry, and temperately warm, for this warmth, will ſomewhat dry up the moiſture which is in the Powder, and cauſe it to fire ſooner, wherefore the Powder doth not work ſo forcibly in the firſt Shot, as it doth in the

ſecond

ſecond. — The Third and Fourth Shots will be much like the Second. And now I will give you the reaſon, why as the Piece grows hotter, one Shot will not exceed the laſt before it, but every time come ſhorter and ſhorter.

The Piece waxing hotter, and by how much the hotter, by ſo much the more attractive is the concavity of the Piece made; and becauſe the Shot is driven forth, or expelled, with no other thing then by the airy exhalation, or wind cauſed through the Salt-Peter; therefore, by making ſuch a Piece the more attractive with the more heat, which ſuppeth and retaineth continually more and more of that Wind which ſhould ſerve to expel the Bullet; the vertue expulſive in that Piece, doth continually, more and more decreaſe, and the Shot flyeth not with that ſwiftneſs as it did before, although the two firſt things; that is, the breaking of the Aire, and the drying of the Powder every time more and more doth help much the Rainge of the Shot; which aid and help, as it is to be believed, that ſomtimes it ſupplyeth, and, perchance, gives advantage to that expulſive virtue which continually the Piece doth diminiſh or ſup in, according as it heateth: So that the Third and Fourth Shots, will not be much differing from the Second Shot; nevertheleſs, in continuance of time, the ſaid two accidents (that is, the opening of the Aire, and drying of the Powder by the heat of the Piece,) cannot ſupply the Third accident; that is, the virtue attractive, by reaſon, the attraction is augmented as the Piece heateth. And this cauſed my Sixth and Seventh Shots to convey the Bullet 22 Paces ſhorter then the Firſt.

CHAP. XXXI.

Concerning Shooting *in a* Morter-Piece, *and of ſeveral* Fire-Works, *both for* Sea *and* Land *Service.*

MOrter *Pieces* are made of the ſame Metal (Braſs or Iron) as *Ordnance* are made of; in the making (or Caſting) whereof theſe proportions are to obſerved.

Suppoſe

Suppoſe the *Diameter* at the *Bore* to be *Nine Inches.* Then

The Length of the *Morter* muſt be 18 Inches.

The *Chamber* in which you load with Powder 3 Inches Diameter, and 4 Inches and a half deep.

The Thickneſs of the *Metal* about the *Touch hole*, 3 Inches. And

The Thickneſs of *Metal* at the Mouth of the *Morter* one Inch and a half

To Prepare Granadoes *for a* Morter.

The Diameter from out to out of the Metal of a *Granado Shell*, ought to be one tenth part of an Inch leſſer then the Diameter of the bore of the *Morter*, becauſe of cording them to fling into the Mouth of the *Morter*, and alſo for fear of ſecret *Cracks*, *Flaws* or *Hony Combs*, which cannot eaſily be diſcerned; let them thus prepared, juſtly fit the *bore* of the *Morter*.

A Granado.

To make Fuſes *for* Granado Shels.

In every *Granado Shell*, there is a hole left to put in a *Fuſe*, or peece of wood in form of a Fawſet for a Spigot, which hole is to be one quarter the Diameter of the wooden *Fuſe*; and the length of the *Fuſe* muſt be about three quarters of the diameter

Diameter of the *Granado Shell*, and made taper, and when filled with the *Compoſition* Following; it muſt be gently driven in amongſt the Powder that is in the *Shell*, leaving a little of it without.

The Compoſition *for the* Fuſe.

Take one Pound of *Powder*, four Ounces of *Salt-Peeter*, one Ounce of *Brimſtone*, all beaten to Powder, and ſifted ſeverally through a fine Searſe. Theſe ingredients well mixed together, making your *Compoſition* fit for uſe.

How Granadoes *are to be* Charged *in the* Morter.

Great care ought to be taken in the Loading and Charging of the *Morter*, and for the ſafe and effectual performance thereof, obſerve theſe following *Directions*.

Firſt, Weigh the Powder which you put into the *Chamber* very exactly, and after it put in a cloſe wad of Hay; which done, cut up a Turf of the ground, that may fill the botome of the *Bole* or *Bore* of the *Morter*, next to the Wad, which is better than a *Tampion* of wood.

Secondly, Your *Grannado* being prepared, ſling it into the Mouth of the *Morter*; obſerving to have the *Fuſe* of the *Granado* juſt in the Center of the Mouth of the *Morter*.

Thirdly, Go to the Breech of the *Morter*, and there thruſt up a Wyre into the Touch-hole, to make all ſure, and then prime it with good dry Powder, ſuch as you may be ſure will take Fire, for upon this, both your own Life, and the ſafety of the *Morter* (beſides the diſgrace) do depend.

Directions for Firing,

Provide ſmall *Fuſes*, of about one quarter of an Inch bore, three quarters of an Inch in thickneſs; and eight Inches long. Fill theſe with good Powder duſt, moiſtned with *Oyle* of *Salt-Peter*, moiſten it but a little, and put it in with an Iron Rammar.

Rammer. Then try whether you like the time that they continue burning, and if you find they burn too ſlow, leſſen your quantity of *Oyle* of *Peter*; but if too faſt, adde more *Oyle* thereto.

All things being thus ready, Thruſt the Pike of your *Linſtock* in at one end of the Fuſe, you intend to give fire at; and bid one of your Aſſiſtants come on one ſide of the Mouth of the *Morter*, and give fire to your Fuſe, wherewith fire the Fuſe in the *Morter*, and then with ſpeed give fire to the Touch-hole. It is far more certain to fire a *Morter-piece* with Fuſes then with *Match*, which doth often fail.

How to Level the Morter Piece *that it may make an effectual* Shot *at any* Mark *aſſigned.*

You ought (as in finding the Rainges of other Pieces of Ordnance) to get leave to try One, Two or Three Shots for practice, without breaking of the *Shell*, which you may thus effect.

Firſt, Fill the Shell with powder, then put it out again, and Weigh it exactly, and fill the Shell again with the like weight of Earth.

Secondly, Take a *Fuſe*, and at the end of it tie 3 or 4 ounces of powder, which put down with the *Fuſe* amongſt the earth firſt making way for it by thruſting in a Staffe,

Thirdly, Level your *Morter* by help of a *Square* or *Quadrant* to (always) above 45 degrees, and what degrees you mount it to note down carefully.

Fourthly, All things being ready, and the *Shell* in and primed; cauſe One or Two to go and obſerve whether the Fuſe burn all the while the *Granado* is flying, and when the 3 or 4 Ounces of powder takes fire, for hereby you may mend your Fuſe, and try whether it will keep fire.

Fifthly, Theſe things obſerved, Meaſure that diſtance, and note it down under the degrees of mounture, as alſo the Weight of the powder the Morter uſed to convey the Shell that diſtance. And when you have thus done two or three

times, you may gain experience both of your *Fuſe*, and of the true *Range* of the *Piece*: which obtained, if you are to ſtorm a Fort or Caſtle

Sixthly, Take the diſtance to the Town, Fort, or other thing you are to ſhoot at, by which (and your former experiment) you may find at what degree of *Mounture* your *Morter* is to be *elevated* to reach ſuch a *Town*, or the like; and that by the *Reverſe Rule of Proportion*: Thus:

As the diſtance when you made your trial,
Is to the degrees of the then *Mounture*;
So is the diſtance to your deſigned Place,
To the degrees to which the *Morter* muſt be elevated to reach that deſigned Place:

EXAMPLE.

Imagin that you made your Experimental Shot at 46 deg of *Mounture*, and the Shell flew 320 Paces; how many degrees muſt the *Morter* be elevated, to caſt its *Shell* 280 Paces, the diſtance that the place you are to ſhoot at, is diſtant from the Morter?

Multiply 320, by 46, the Product will be 14720, which divide by 280, the Quotient will be 52 Paces, and almoſt a half, and to ſo many degrees of *Mounture* muſt the *Morter* be *mounted* to convey its Shell 280 Paces.

Some Cautions relating to the foregoing Section, concerning the Morter-Piece.

1. Let your *Powder* (when you are to ſhoot often to the ſame place) be all of the ſame ſtrength and goodneſs.
2. Uſe not *Tampions* of *Wood*, but a *Wad* of *Hay* and a *Turf* of *Earth*, both rammed in with the like ſtrength.
3. Try your *Shells* before you fill them, by putting in a little Powder, and firing it, immediately ſtopping the *Fuſe-hole* with *Clay*, for if any Smoke come out, the *Shell* is defective.

4. Weigh

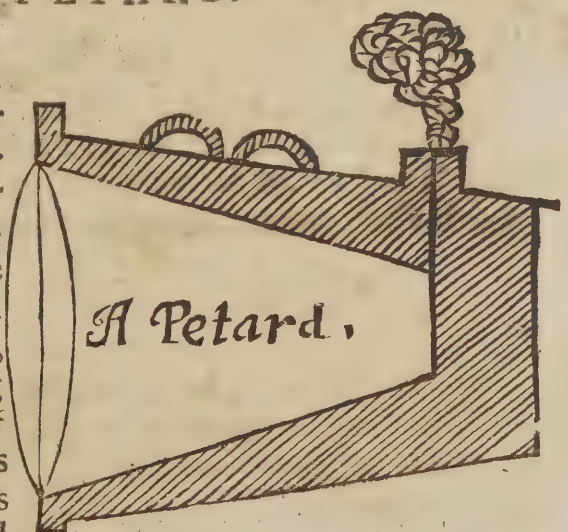
4. Weigh every *Shell* before you fill it, and make them all of one Weight, by putting in thereto ſo many Muſket Bullets as will make their Weight even.
5. Fill your *heavieſt Shell* with Powder (for that will contain leaſt Powder) which done, pour it out again, and weigh it very exactly; for ſuch a quantity (and no more) will ſerve all your *Shells*.

To make Granado's *to be caſt out of Mens Hands.*

Theſe ſmall *Granadoes* are of no leſs eſteem than the greater, either for Offence or Defence: To make them, Firſt fill thoſe ſmall Shells with fine Gun-powder, then make *Fuſes* of one Pound of *Gun-powder*, ſix Ounces of *Salt-peter*, and one Ounce of *Charcole*: Or if you would have them of leſs durance, you may make them of the *Compoſition* for Great *Granadoes*: Knock the *Fuſe* up to the head within one quarter of an Inch, which is only to find it out by in the Night: Stop well the reſt of the hole in the *Granado*, (and other flaws if any be) with ſoft Wax, then Coat it with Pitch and Hurds leſt it ſhould break with the fall; and be ſure, that as ſoon as you have fired the *Fuſe*, you caſt the *Granado* out of your hand.

Of the PETARD.

Theſe *Petards* are made of Copper and Braſs mixed; and their dimenſions are fitted according to the uſe for which they are prepared; there being three chief uſes of them, and ſo many ſorts there are, *viz.* ſome for blowing up and breaking of Bridges; others for Gates that have Perculliſies belonging to them; and the third ſort for ordinary Gates



A Petard.

1. Thoſe for Bridges are commonly 11 Inches long, and at the breech ſeven Inches and a half about, and 5 Inches wide within; the Metal at the breech muſt be one Inch and a Quarter thick, and at the neck half an Inch thick, beſides the Muzzel-ring; the mouth muſt be 10 Inches wide, and to the Touch-hole muſt be added a Pipe, as is in the Figure.

2. The ſecond ſort for Gates with Perculliſiſes, muſt be 9 Inches long, almoſt half an Inch thick at the neck, and an Inch thick at the breech, the mouth muſt be about 7 Inches wide, and the outſide of the breech muſt be ſix Inches wide, and the inſide four Inches.

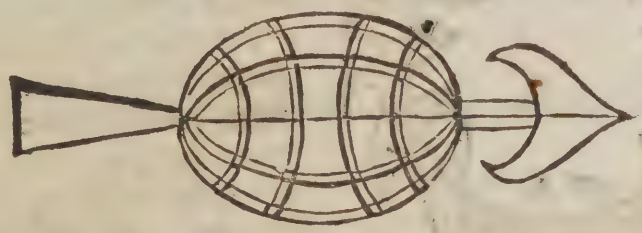
3. The third ſort, which is for Gates and Paliſadoes, muſt be ſeven Inches long, one fifth part of an Inch thick at the neck, and three quarters of an Inch at the breech, the mouth muſt be 4 Inches wide, at the outſide of the breech it muſt be 3 Inches and a half, and at the inſide thereof 3 Inches.

The Charges for theſe *Petards* are to be of the fineſt powder that can be got, beaten hard in the *Petard*, yet not to break the Gun, then muſt it be ſtopt cloſe in with a Board of about an Inch thick, juſtly fitted thereunto with Wax melted to ſtop the Criveſſes about to keep out water, you muſt not charge it up to the top, but leave the breadth almoſt of two Inches empty, which muſt be filled up with Tow cloſe ſtopped in, and a linnen Cloth bound about the *Petards* neck to keep it cloſe in.

The Touch hole muſt be ſtopped with a Cork, and over that a Sear-cloth to keep it from the Wet.

The Charge for this ſort of *Petard*, is 5 or 6 pound of powder. Thoſe of the ſecond ſort from 3 to 4 pounds. And for the ſmalleſt, from one pound and a half, to one pound.

To make Darts *or* Fire-Arrows.



A Fire-Dart or Arrow.

Provide a long Staff, and joyn unto it an Iron head, and about the middle of that head of Iron, having firſt made a Bag of ſtrong Canvas, in form of an Egg, leaving open at the end a hole to fill the Bag with the *Compoſition* following,

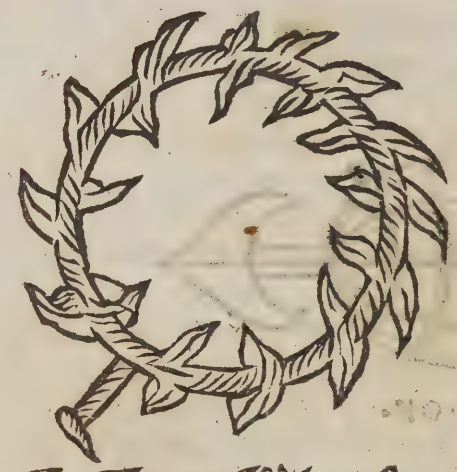
Take one Pound of *Salt-peter*, half a Pound of *Gun powder*, and as much *Brimſtone* in Powder, mix all theſe together with Oyl of *Petriol*; with this *Compoſition* fill the *Bag*, round about the *Arrow-head*, and bind all about with nealed Wyre.

For the *Priming* of theſe *Darts* or *Arrows*, Dip *Cotton-Week* into *Gun-powder* wet with water, and let the *Cotton* be well dried before you uſe it.

For the joyning of the *Staff* to the *Arrow-head*, let it be done very ſlightly, that the *Arrow-head* being faſtned into any thing, thoſe may be deceived that intend to pull out the *Head*, for they will pull out the *Staff* only.

How to make Fire-Wheels *to be caſt out of Mens Hands.*

For the making of theſe, you are to uſe theſe Ingredients: Take four pound of *Powder* in Duſt, one pound of *Charcoal*-duſt, two pound of *Tar*; two pound of *Salt-peter*; and one pound of *Rozen*: All theſe Ingredients being well incorporated,



A Fire Wheele.

ted, and heat over a gentle fire; ſteep *Toe* or *Flax* in the ſame, and then wrap the *Toe* or *Flax* about a *Hoop*, and then cover all this again with *Powder-duſt*; and when you uſe them, give fire to them, and caſt them among your *Enemies*; the *Hoops* ought not to be too big; but if you will, you may bind two of them a croſs, like a *Tavern-Buſh*, and then fire and fling them as afore.

To make a Compoſition *to fill* Pikes, Darts, Javelines, Trunks, Balls, *and other* Fire-works; *to defend a Ship or Breach, or to enter the ſame: Or to ſtick into the ſide of a Ship, or other Place.*

Take of *Powder* bruiſed eight Pound; *Peter* in *Roach* one pound; *Peter* in Meal one pound; *Sulphur* in Meal two pound; *Rozen* three pound; *Turpentine* one pound; *Vert-de-greace* half a pound; *Bolearmonick* 5 Ounces; *Bay* Salt ſix Ounces; *Colofonia* 3 Ounces; *Arſnick* 2 Ounces. Mix theſe very well together: This Compoſition when fired will burn very furiouſly with a Blew and Greeniſh colour.

The Caſes, Bags or Balls, which you fill with this Compoſition, muſt (when filled) be *Armed* about with ſtrong Twine or Cord, and then covered over with this *mixture*, melted in a Pot.

Pitch 4 pound; *Lin-ſeed Oyl* one pound; *Turpentine* 5 Ounces; *Sulphur* one pound; *Tar* 5 Ounces; *Tallow* one pound.

Your *Fire-works* thus prepared are fit for ſervice at any time; but when this outer Coating is cold, bore two holes with an Iron Bodkin, filling the ſame with fine Mealed Powder, putting in a ſmall ſtick at each hole, which take out when you prime them for firing.

Fire

Fire-works made of the *Compoſition*, and *Arming* as aforeſaid, may be ordered ſo as to be thrown out of mens *hands*, ſhot out of a *Muſket*, or out of a *Croſs* or *Long Bow*; which may be of good uſe to fire *Sails*, *Thatched Houſes*, *Stacks* of *Corn* or *Hay*, &c.

To make a Compoſition *that will burn and feed upon the water.*

Take of *Maſtick* half a pound; *White Frankincenſe*, *Gum Sandrake*, *Quick Lime*, *Brimſtone*, *Camphire*, *Gun-powder*, of each one pound and a half; *Rozen* one pound; *Salt-Peter* four pounds and a half: All theſe mixed together when fired will burn violently and feed upon the water.

To make a Compoſition *that will burn under the Water.*

Take of *Brimſtone* one pound; *Gun-powder* ten Ounces; *Salt-Peter* one pound and a half; *Camphire* beaten with *Sulphur* and *Quick-ſilver*: Mix theſe well together with *Oyl of Peter*, or *Lin-ſeed Oyl* boyled; fill a *Ball* or other *Caſe* of *Wood*, or *Tin*, with this *Compoſition*; Arm it as before, and ballaſt it with Lead at the bottom; make a ſmall hole at the top, and fire it well and throw it into the Water.

F I N I S.

OF THE

MEASURING OF *Heights, Depths,* and *Distances.*

1. *How to take the Height of a Tree, Tower, Steeple, or other upright Building, by the Length of the Shadow thereof.*

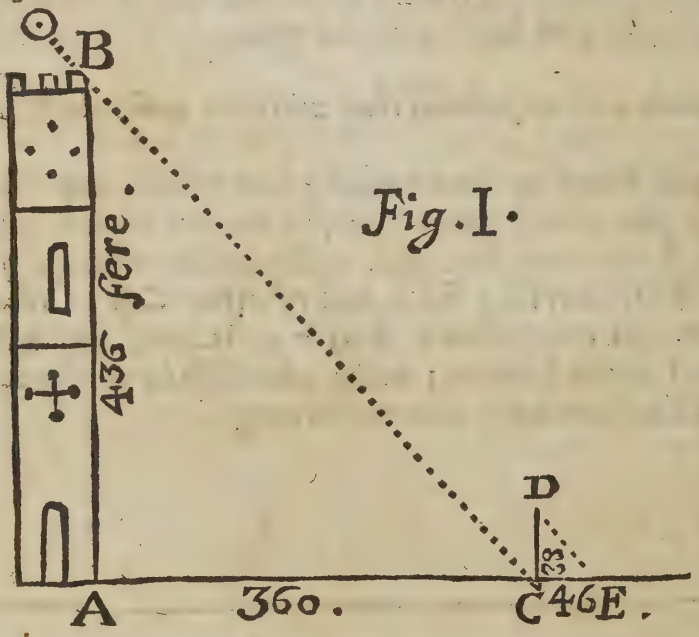


Fig. I.

LEt B A be a *Caſtle-Wall,* or the like, and the Sun ſhining caſts the Shadow thereof upon plain ground to C, now having a *Walking-ſtaffe* in my hand, I ſet that upright at the end of the ſhadow of the *Wall* at C, and I find, that my *Staffe* caſts its ſhadow to E, where I make a Mark, as alſo another at C, then meaſuring my *Staffe,* I find it to be 38 Inches long, and meaſuring the length of the ſhadow thereof C E, I find that to be 46 Inches. Then I meaſure the length of the Shadow of the *Caſtle Wall* A C, and I find that to be 30 foot, which is 360 Inches

Inches: Now for the height of the *Caſtle Wall*, you muſt work by the Rule of Proportion thus: Saying,

As C E, the *Length of the Shadow* of my *Staffe* 46 Inches,
Is in proportion to the *Length of Staffe* C D, 38 Inches.
So is A C, the *Length of the Shadow* of the *Wall* 360 Inches:
To 435 $\frac{3}{8}$ Inches, for the height of the *Caſtle Wall*; which you may call 436 Inches.

For, If you multiply 46, the *Length of the Shadow* of the *Staffe*, by 360, the Length of the Shadow of the *Wall*, the Product will be 16560, which being divided by 38, Inches the length of the *Staffe*, the Quotient will be 435 $\frac{3}{8}$ Inches, which reduced into Feet is 36 foot 3 Inches and $\frac{3}{8}$ of an Inch which you may call 4 Inches, and ſo high is the *Caſtle Wall*.

II. *How to take the height of a* Watch-Tower, *by the* Shadow, *when you cannot come to the bottome of it, to meaſure the length of the* Shadow.

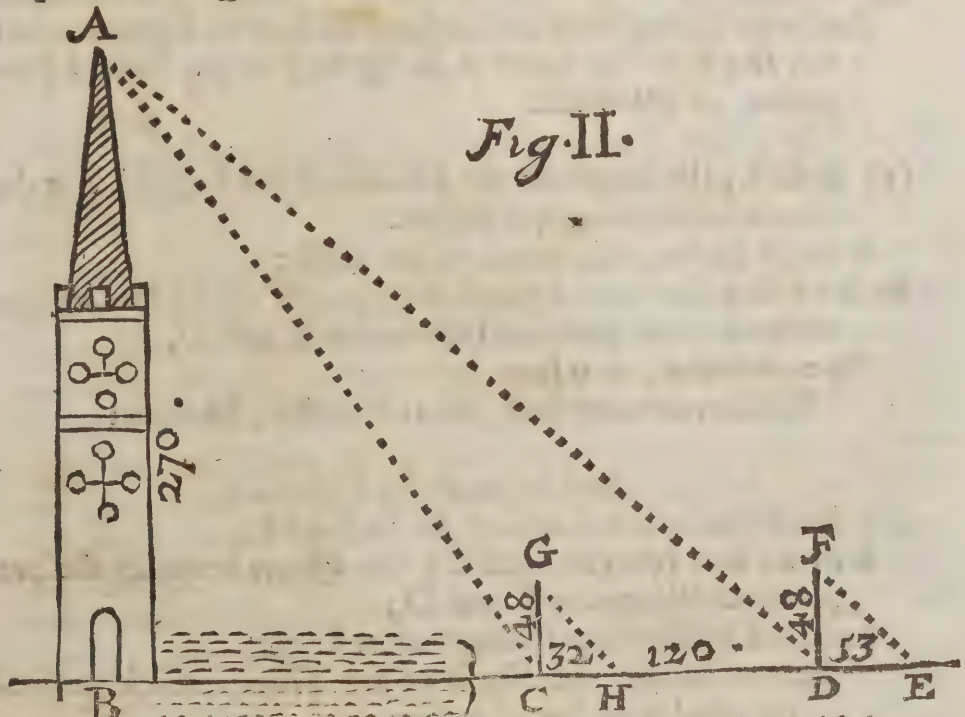


Fig. II.

LEt A B, be a *Watch Tower*, whoſe height I would know, by the *Shadow* thereof, but there is a Moat about it, as

B C, so that I cannot come to measure the *Shadow* thereof; However,

I come near to the Moat side, and there I find the *Shadow* of the top of the *Tower* to cast at C, where I erect my *Staffe* C G, and that casts its *Shadow* to H; I measure the Length of my *Staffe*, and I find it 4 foot, or 48 Inches; and the Length of the *Shadow* thereof C H, I find to be 32 Inches, these two I note down.

Then, some time after, (when the Sun is lower) I come again to the place, and find the *Shadow* of the top of the *Tower* to cast at D, where again I erect the same *Staffe* of 4 foot long, and find that it casts its *Shadow* to E, and that the length of the *Shadow* thereof, D E, is 4 foot 5 inches, or 53 inches and somewhat better, this I also set down, and then I measure the distance between the two places where the Tower casts its *Shadow*, at the *First* and *Second* time of my *Observation*, namely, the distance C E, and find it to be 10 foot, or 120 inches.

And now having all these numbers set down, I come to find the *Height* of the *Tower* A B, by help of the *Rule* of *Proportion*, as followeth.

(1) As D E, the length of the *Shadow* of the *Staffe* D F at the *Second Observation*, 53 Inches.
Is to 48 Inches, the length of the *Staffe*;
So is 10 foot (or 120 Inches) the Length of the *Shadow* between the two places of *Observation* C and D,
To 108 Inches, or 9 foot.
Which number 9 foot, or 108 Inches, set down

And say again by *Proportion*,

(2) As 48 Inches the *Length of the Staffe* G C,
Is to 10 foot (or 120 Inches) the *distance* between the two places of *Observation* C and D;
So is 108 Inches (the *Number* before found)
To 270 Inches, the *Height* of the *Tower*, which reduced into *Feet* is 22 foot 6 Inches.

III. *How*

III. *How to take the* Altitude *of any upright building, or the like, by a* Bowle of Water.

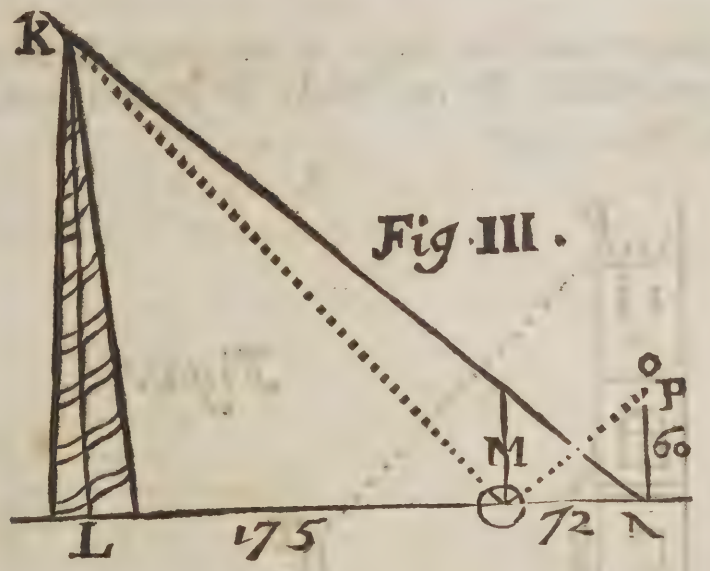


Fig III.

TRavelleing a long the Road I ſee a *May-pole*, as K L, the height whereof I would gladly know, but having no *Geometrical Inſtrument*, I procure a *Bowl* of fair *Water*, which I ſet down upon the ground, at M. And then, when the Water is ſtill in the Bowl, I go backward, in a right line from the *May-pole*, till I ſee the Shadow of the top of the *May pole* in the middle of the Water; which I do when I come at N, and at N, I make a Mark upon the Ground: Then do I meaſure the diſtance from the foot of the *May-pole* at L, to the *Bowl of Water* at M, and find it to be 175 Inches: Alſo, I meaſure the diſtance from the *Bowl of Water* at M, to the place of my ſtanding at N, and find that to be 72 Inches: Then I meaſure the *Height* of my eye from the Ground O N, and find that to be 60 Inches; Theſe things known, I ſay by the *Rule of Proportion.*

If 72 Inches diſtance M N, give 60 Inches Altitude N O;

What Altitude ſhall 175 Inches the diſtance L M give?

Anſwer $145\frac{60}{72}$ Inches.

For, if you multiply 175 by 60, the Product will be 10500, which divide by 72, the quotient will be $145\frac{60}{72}$, that is almoſt 146 Inches, which is, 12 foot 2 Inches for the height of the *May-pole* K L, required.

IV. *How to take the height of any upright* Building, *that is approachable, by two* Sticks *or* Rulers *joyned together,* Square-wiſe.

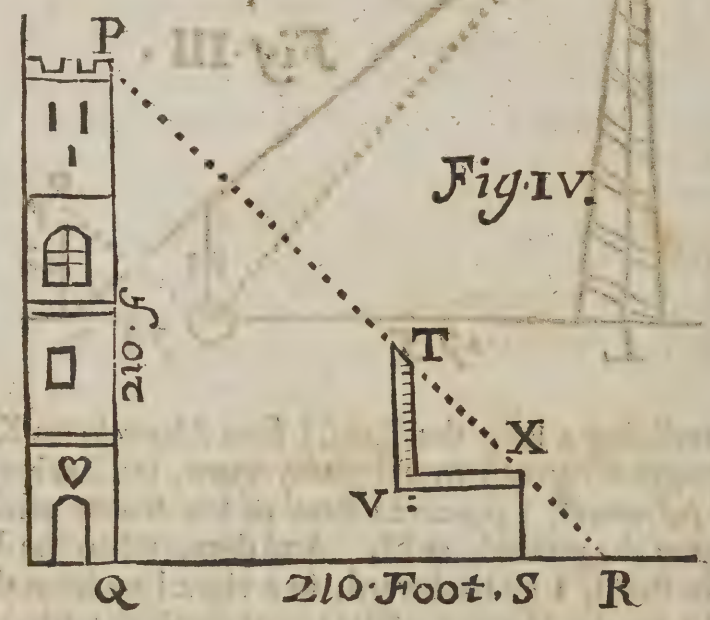


Fig. IV.

LEt P Q be ſome *Structure,* ſtanding upright upon plain Ground, whoſe height you require.

Go unto ſome convenient *Court, Yard, Garden,* or other piece of *level Ground* adjoyning to the building to be meaſured, then take your Square in both your hands, holding it perpendicular, which you may do, by having a *Thread* and *Plummet* as T V, hung upon a pin near the top of the Square at T, Then keeping it in this poſture, go backwards, or forwards, (as occaſion requires) till your *Eye* being at X, you can ſee the other end of your Square at T, and the Top of the Building at P, all in one *Right-Line,* which when you do, make a ſtand, as at S

Then

Then measure the height of your *Eye* from the *Ground* X S, with a string, and set that length upon the *Ground* from the place of your standing at S, to R: Then measure the distance from R, to Q, for that shall be equal to the height of the build ing P Q, and is here 210 foot.

V. *How by help of this* Square, *standing upon a* Platform *of a known height, to find the* distance *from the* Platform, *to any* Tree, River, *or other* Object *that is remote from you,*

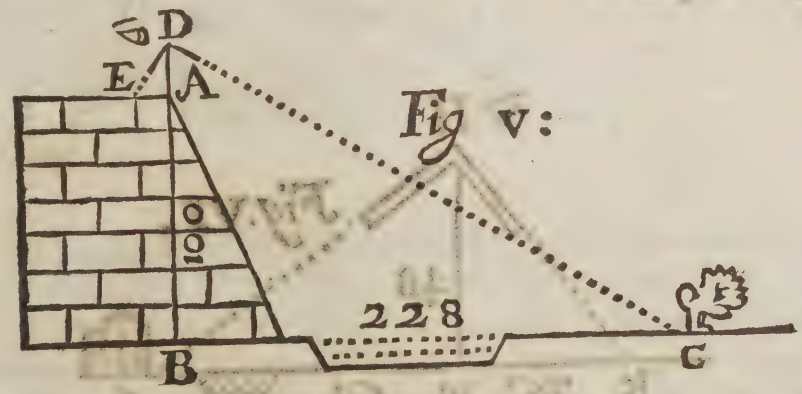


Fig V:

LEt A B be a *Platform*, whose Perpendicular height is 100 foot, being upon the top thereof at A, I would know how far the *Oake* at C, is distance from the bottom of the *Platform* at B.

Upon the top of the *Platform* at A, I erect a Pike or *Javeline* 12 foot long, more or less, upon which, I hang the *Angle* of my Square: And I look with my *Eye* at D, along the side of my Square, till I see the bottom of the *Oake* at C, and in this position I fix my Square, with a *Screw* or the like, to the head of the *Javeline*: Then from D, I extend a thread or *Line* by the *side* of my Square, til it touch the *Platform* at E, and then I measure the distance upon the *Platform* from A to E, and find it to be 24 foot, 6 Inches, then by proportion I say

As

As 12 foot, the *Length of the Javelin* D A,
Is to 24 foot and a half, the distance measured upon the *Platform* A E,
So is 112, the height of the *Platform* and *Javelin* together B D.
To 228 foot 8 Inches, for the distance B G.

VI. *How to take the* distance *from the place of your standing upon level* Ground, *to any* Tree, Tower, *or other thing, remote from you, though you cannot come neer the same, by your* Square.

Fig. VI.

STanding at F, I see a *Coundit-head* at G, whose distance from F where I stand, I would know, but I cannot come neer it for a *River* between F and G; However,

At F, I erect a *Staffe* of 4 foot high, (or 48 Inches) as F H, upon the end whereof I hang the *Angle* of my Square, and I look by the side thereof, till I see the foot of the *Coundit-head* at G, and fixing my Square there, I extend a line from H, by the side of the Square, till it touch the *Ground* at K: Then measuring the distance between F and K, I find it to be 3 foot or 36 Inches: Then by the *Rule* of *Proportion* I say,

As 36, the distance K F,
Is to F H, the *Length* of the *Staffe* 48 Inches:

So

So is 48 inches, the length of the Staff F H:
To 64 inches; for the *Distance* F G;
For as often, as K F, is contained in F H,
So often is F H, contained in F G.

VII. *How to take the* Breadth *of a* River *by the Square.*

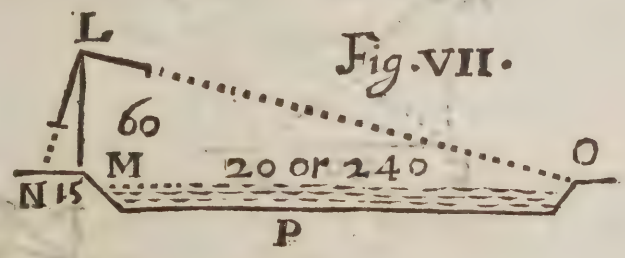


Fig. VII.

THere is a *River* M P O, whose breadth I desire to know: Upon the brow of the *River* at M, I set up my *Staff* M L, which is 60 inches (or 5 foot) long, and hanging my *Square* upon the end thereof at L, I look by the *Side* thereof, till I see the *Brow* of the *River* on the other side at O, and there fixing my *Square*, I extend a *Thrid* by the *Side* thereof, from L to N, then measuring the distance L N, I find it to be 15 inches (or 1 foot 3 inches) then I say by Proportion,

As N M, the *distance* measured; 15 inches
Is to L M, the *length* of the *Staff* 6 inches.
So is L M 60 inches.
To M O, 240 inches, (or 20 foot, for the *breadth* of the *River* M O.

VIII. *How*

VIII. *How to take the* Distance *between Two* (*or more*) Places, *without coming near any of them, by a Two Foot* Joynt Rule.

Fig. VIII.

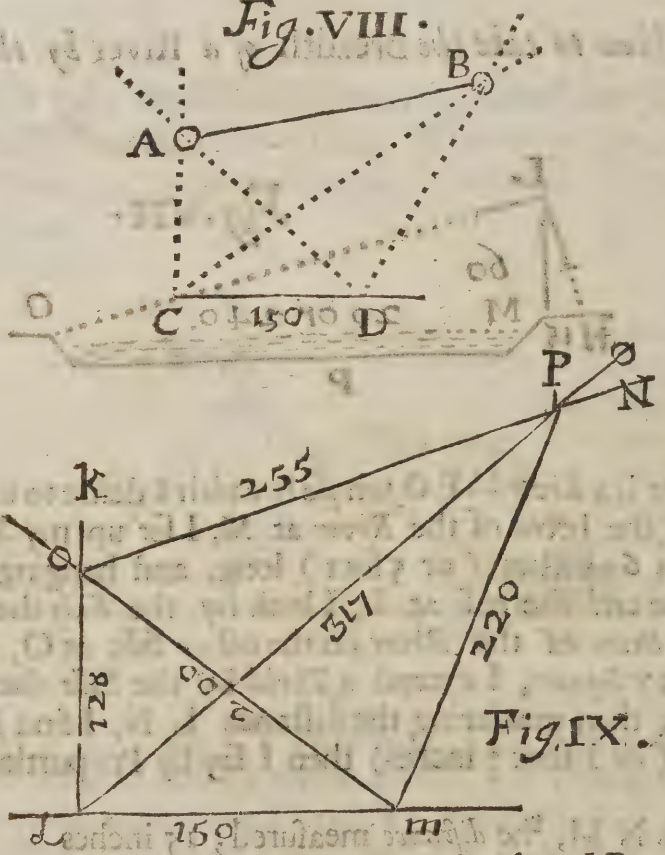


Fig. IX.

LEt the two remote Places given, be A and B, whose distance I would know, but I cannot approach, or come near either of them, and I have no other *Instrument* but my *Two Foot Joynt Rule*; however, I make choice of a Place at C, from whence I can see both the Places A and B, and there I set up a *Staff* whereon to rest my *Rule*, and opening it to a *Square Angle*, I look by one side of it, till I espie my first place, at A, and there keeping it fast, and level, I look by the other side of the *Ruler*, and cause a *Mark* to be set up in a right

right Line from C, at a competent distance from C, as at D, 150 foot, then close in your *Rule*, till by the side thereof you see your *second* place at B, keep your *Rule* at that Angle:

Then having a sheet of Paper, or upon a Board, as Figure IX. draw two Right Lines thereon, as K L, and L M, making a *Right* (or *Square Angle*) at L.

Then bring your *Ruler*, (it being still kept at the Angle it was when you looked to B,) and lay the *Center* of your *Ruler* upon L, and by the side of it draw a Line L M, and, because your measured distance between C and D was 150 foot, take 150 quarters of *Inches* (150 of any equal parts that you have upon your Ruler) and set them down upon your *Paper* or *Board*, from L to M.

Then take your *Rule* and go to D, and set the *Center* of it upon the *Staff*, look by one side thereof to C, and by the other to A, then bring the *Rule* to the *Board*, and lay the Center thereof on M, and one side upon the line M L, and by the other side, draw a Line at length as the Line M O, crossing the Line L K in O, so shall O, upon your *Board*, represent the *Place* A in the *Field*: Again, Take your *Rule*, and go to D, and there resting it upon the *Staff*, look by one edge to A, and by the other to B, and keeping it at that Angle, bring it to the *Board*, and lay one *Side* upon the *Line* M O, and by the other draw the Line M P, crossing the Line L N in the Point P, so shall P represent upon the *Paper* the Second Place B in the Field, and being measured upon the same *Scale* whereof L M was measured, it will be found to be 250 foot, and that is the distance from A to B. And by this means you may find the distances of all the Places in the Figure, if you measure them upon the same *Scale* as L M, or O P were measured, and so shall you find

The Distance	L O L P M O M P	to Contain	128 317 200 220	Foot

X. *How to take the* Distance *between* One *or more* Places, *by a* Ten Foot Rod (*divided into* Inches) *only.*

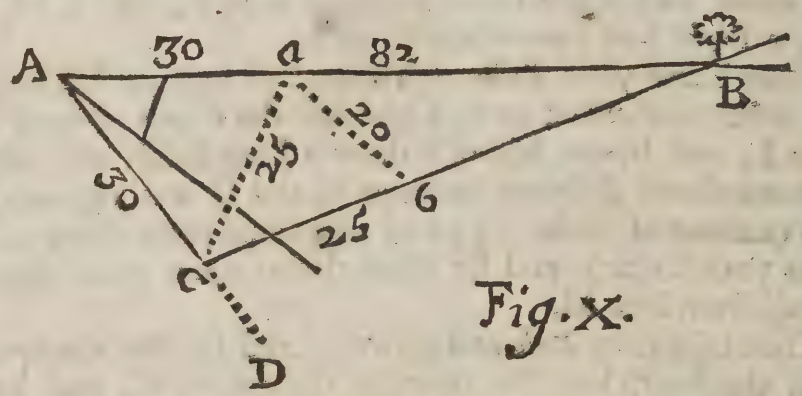
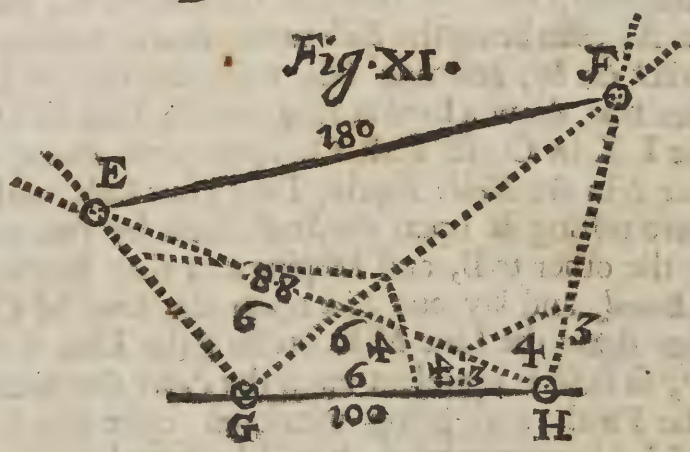


Fig. X.

Fig. XI.



STanding at A, I would know how far it is to the *Tree* at B, though I cannot come near it.

Standing at A, I measure in a right Line from thence 30 foot, from A to *a*: And then looking towards D, I measure out 30 foot more, and from A to C; and measuring the distance *a* C, I find it to be 25 foot, which laid down upon Paper do make the *Triangle* A C *a*, of which draw the Line A *a* out at Length,

Then standing at C, I measure in a right Line towards B, 25 foot, from C to *b*, and the distance between *a* and *b*, I measure

measure to be 20 foot, which makes the Triangle C *a b*, Draw the Side C *b* at Length, till it eroſs the former Line A *a*, extended in B; So ſhall the Line A B, (being meaſured by the ſame *Scale* that the other *Lines* were laid down by) be found to contain 82 foot, and ſuch is the diſtance between A and B.

And according to this *Method*, may the *diſtances* from ſeveral Places be meaſured, As in Figure XI. Where ſtanding at G and H, you may find the *diſtance* between E and F; and alſo, all the other intermediate diſtances, as from G or H, to E or F, as alſo the diſtances G E, G F, H E, H F, *&c.* as by the *Figure* is evident.

F I N I S.

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